

MOSSES

WITH HAND-LENS AND MICROSCOPE

A NON-TECHNICAL HAND-BOOK OF
THE MORE COMMON MOSSES OF THE
NORTHEASTERN UNITED STATES

PART III

BY

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spores in spring. Common on the Pacific coast but infrequent eastward. Very variable, but distinct from all our other species by the italicized characters.

T. ruraliformis (Besch.) Dixon is a more robust plant of the Rockies and westward, having its leaves acuminate and the whitish lamina of the apex running up the base of the hair-point.

T. mucronifolia Schwaegr. Loosely tufted, monoicous; leaves oblong-spatulate, margins reflexed below; costa excurrent into a *smooth hair-point*, upper leaf-cells hexagonal, *smooth both sides*; capsule ovoid-cylindric, lid elongated-conical; basal membrane $\frac{1}{3}$ – $\frac{1}{2}$ the height of the entire peristome; spores in summer. On soil and stones, rather infrequent in our region.

T. papillosa (Muell.) Wils. is not often collected, but is probably as common as any of our species. It never has been found fruiting except in Australia and

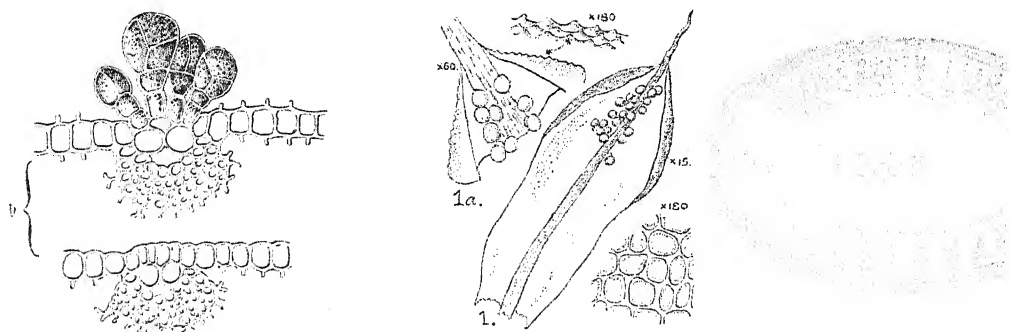
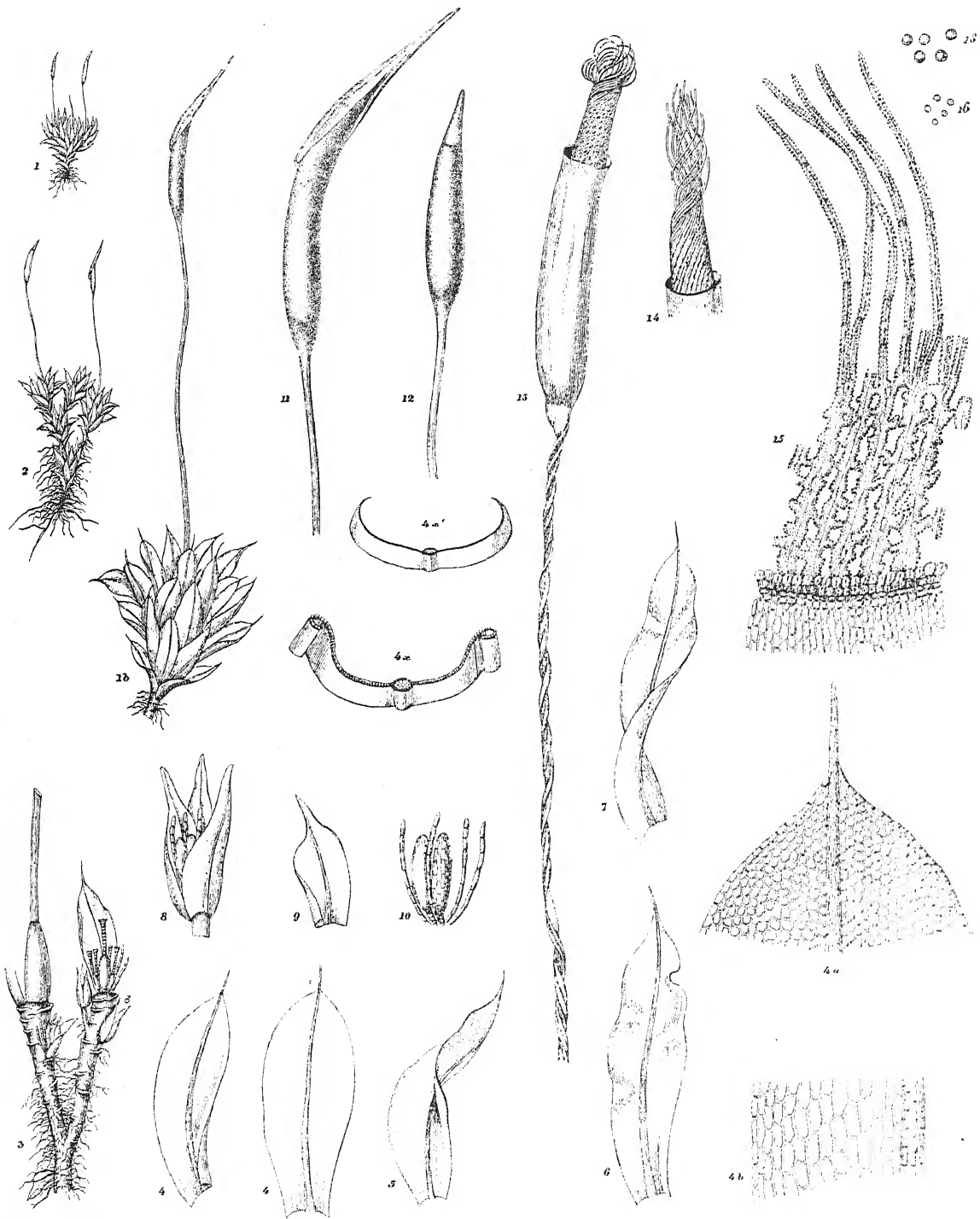


FIGURE 79. *b*. Cross-section through the costa of *Tortula papillosa*, showing papillae at back and brood bodies on the inner surface. (After Limpricht.) *t*, *ta*, etc. Leaves and leaf-cells of the same. (After Dixon.)

New Zealand and must be often overlooked. The plants are small, less than 12^{mm} in height, and are readily known by the concave papillose leaves with the margins strongly involute, bearing on the upper surface of the costa numerous multicellular propagula as shown in Fig. 79. The papillae on the leaves are simple except at the back of the costa. This species, unlike its relatives, grows on the bark of trees. *T. pagorum* (Milde) DeNot has been collected on bark of trees in Georgia by Dr. John K. Small. It is similar to *T. papillosa* but has *compound papillae*, *costa smooth at back* and without brood bodies; but in the axils of the upper leaves are found tiny leaf-like brood bodies, ecostate with a hyaline apiculus.

T. marginata (B. & S.) Spruce is a rare species which sometimes grows on the walls of houses. The leaves are narrowly oblong or lingulate, with a short hair-point, papillose, with margins plane and bordered with a distinct band of 2–4 rows of yellowish linear cells. It is dioicous and matures its spores in spring as a rule.



mucronifolia

PLATE XXXVI. *Tortula mucronifolia* (From Bry. Eur.) 1 and 2. Plants natural size.

Family 11. Encalyptaceae

The mosses of this family grow on soil or stones and are erect and usually caespitose. The leaves in our species are broad and lingulate or spatulate; lower leaf-cells thin-walled and hyaline; upper cells small, dense and opaque, bearing strong verrucose papillæ. The extinguisher-like calyptra (see Plate XXXVII) is the most characteristic thing about the family, and because of it these mosses are often called Extinguisher Mosses. The members of this family belong in the single genus

ENCALÝPTA Schreb.

which is so much like some species of the *Tortulaceæ* that Brotherus in "*Die Pflanzenfamilien*" makes it only a subfamily of the *Tortulaceæ*. In many respects our species strongly resemble the species of *Tortula*. The leaves are large and tongue-shaped and are twisted when dry, but the costa is little or not at all excurrent. In fruiting plants the peristome and the characteristic calyptra are enough to render identification easy, in sterile plants the beginner might make a mistake. The plants are much too large to be confused with *Desmatodon*, and the percurrent or barely excurrent costa distinguishes from all of our species of *Tortula* except *T. papillosa*, which has simple papillæ, or *T. mucronifolia*, which has no papillæ at all.

In *Encalypta* we have a curious combination of peristome characters; the striking similarity of the calyptra and leaves in the various species make it certain that no mistake is made in putting them all in one genus; yet within the limits of this one genus we have almost all degrees of completeness of the peristome, from none at all to one highly developed and double. Some of the peristomes show a strong likeness to the nematodont type, while in *E. procera* there is an almost typical arthrodont double peristome. There seem to be good grounds for considering the peristome of *Encalypta* as a primitive form connecting the two types above mentioned, and I now believe that an arrangement of the families in the following order would better represent their relationships than the one decided upon when the book was begun: Georgiaceæ, Polytrichaceæ, Buxbaumiaceæ, Encalyptaceæ, Tortulaceæ, Ephemeraceæ, Grimmiaceæ, Dicranaceæ, Fissidentaceæ. For a more complete discussion of this matter, see the *Bryologist* 7: 38. 1904.

E. streptocárpa (Hedw.), the Common Extinguisher Moss, is very common on limestone. The plants are very large, 3-6^{cm} in height, and many of the large (about 6^{mm} in length) coarse leaves are strongly incurved at apex and

subcucullate. The costa is rough on the back and does not reach the obtuse and rounded apex. The perichæatial leaves are acuminate; the seta long and reddish; calyptra rough at the tip; capsule long-cylindric, with 8 reddish spiral ribs; peristome double, outer teeth long, red, filiform and papillose; inner peristome half the length of the outer, consisting of 16 or 32 filiform seg-

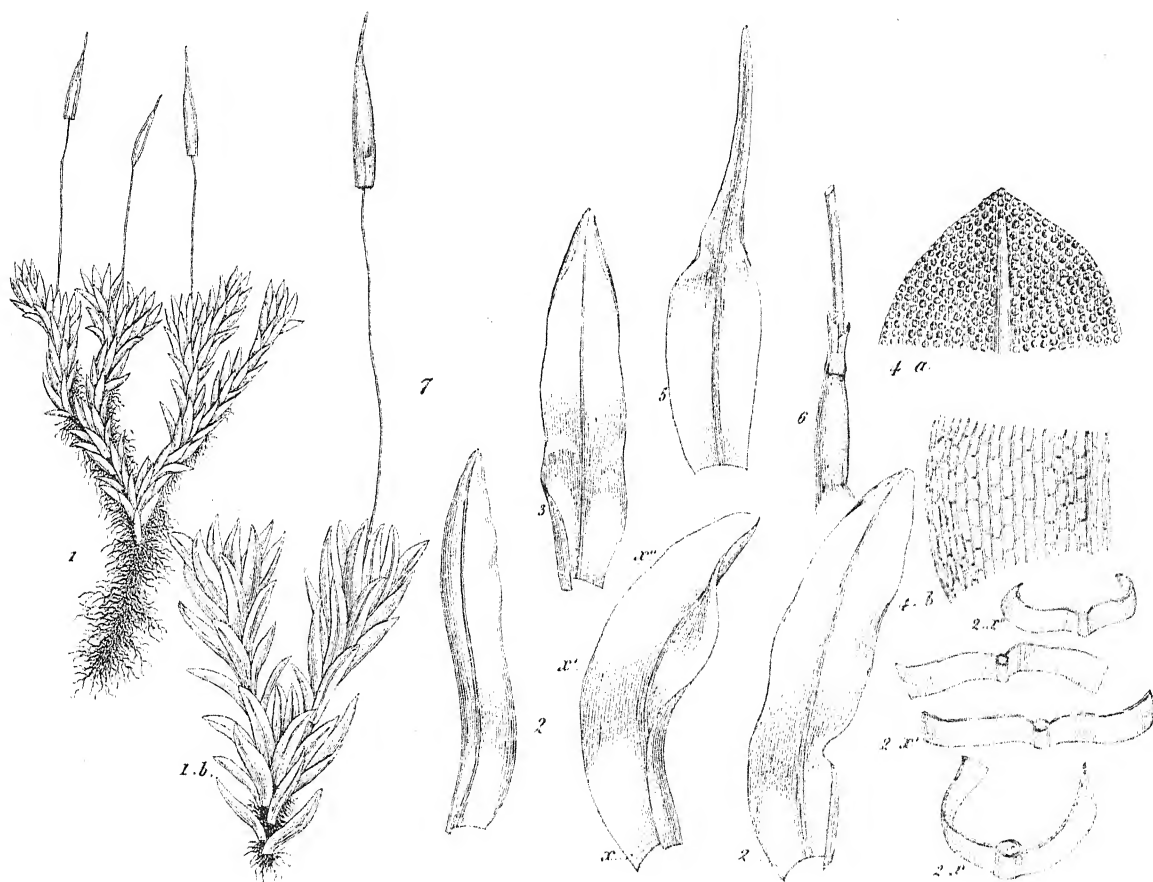


FIGURE 80. *Encalypta streptocarpa*. (From Bry. Eur.). 1. Plant natural size. 1b. Plant enlarged. 2 and 3. Leaves. 5. Perichaetial leaf. 4a. Leaf apex. 4b. Cells from base of leaf.

ments from a basal membrane which is adherent to the teeth. The spores mature in late summer, but so far as I know this species has never been found fruiting in America.

E. ciliata (Hedw.) Hoffm. is a less frequent plant, rather smaller and lighter green than the preceding. In fruit the strongly fringed calyptra will render it unmistakable. When sterile the apiculate leaves, plane margined above, but narrowly recurved below with costa excurrent or ending just below the apex, will

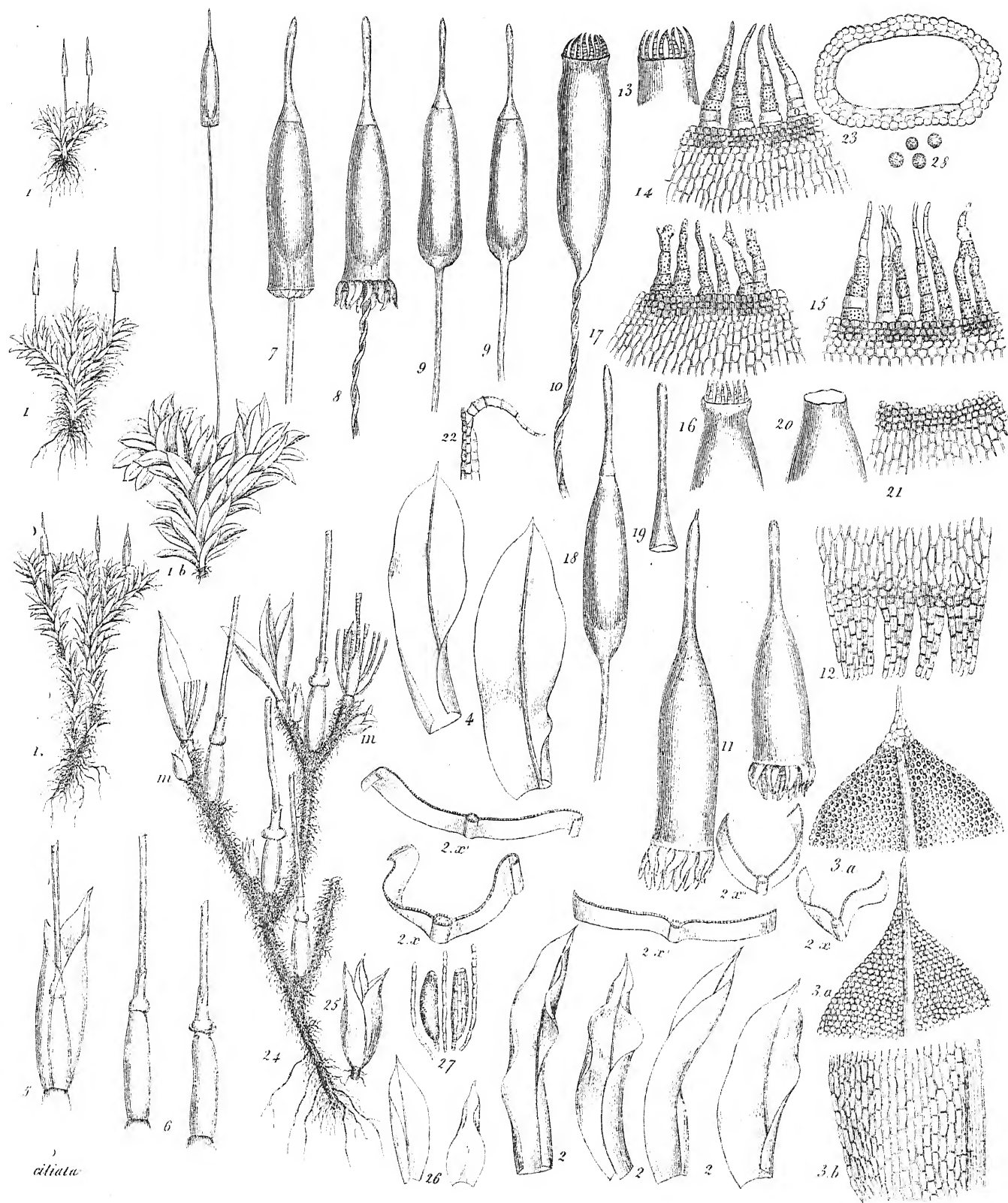


PLATE XXXVII. *Encalypta ciliata* (From Bry. Eur.)

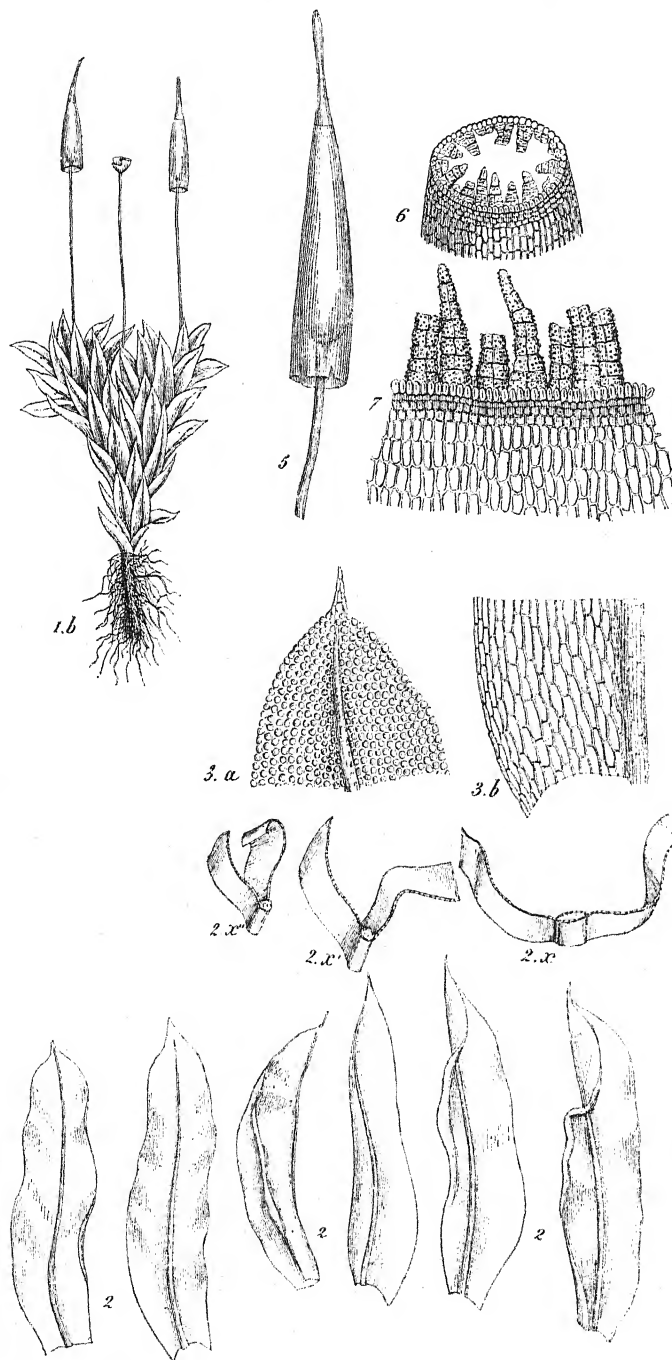


FIGURE 81. *Encalypta vulgaris* (From Bry. Eur.)
1b. Plant enlarged.

usually serve to identify it. The capsules are not ridged when dry; the peristome is single, of 16 teeth; spores maturing in late summer.

E. vulgaris (Hedw.) Hoffm. is rare in America. It is alpine or subalpine; small, about 12mm high or less; leaves obtuse-rounded and apiculate, or more or less acute; costa excurrent or merely percurrent; capsule smooth; peristome simple, of very fragile teeth, or sometimes entirely wanting; spores in late spring.

One who had never seen either species might confuse sterile specimens with *Tortella caespitosa*, from which it is distinguished by its larger lingulate leaves having the hyaline basal area bordered by a few rows of much narrower elongated cells.

The shape and structure of the leaves is similar to that of *Barbula unguiculata*, but the leaves in this species are so much larger that it appears very much more robust, and the leaves are also much more spreading when dry.

GROUP 2. DIPLOLEPIDAE

Peristome double, the plates of the outer side of the teeth (outer peristome) in two rows, separated by a zigzag median line; inner side of teeth of a single row of plates.

Inner peristome thin and membranous, made up of the inner walls of the same cells whose outer walls formed the inside plates of the teeth. (See pages 33 and 34). The teeth of the inner peristome are known as segments, and are usually 16, alternating with the teeth, somewhat keeled, usually arising from a basal membrane $\frac{1}{6}$ to $\frac{1}{2}$ the height of the teeth, and in the highest development separated by 1-3 hair-like cilia of varying lengths. The segments may be opposite the teeth and without basal membrane or cilia as in *Funaria*. The segments themselves may be reduced to a mere filament, as in *Orthotrichum*. The entire inner peristome may be lacking in degenerate types, as in some species of the *Bartramiaceae*, or even the entire peristome may be lacking, as in *Physcomitrium*.

SUBGROUP 1. ACROCARPAE

Sporophyte terminal from erect, or nearly erect stems, sometimes becoming lateral by innovations. In these respects the plants of this subgroup are like most of those of the preceding families.

Family 12. Orthotrichaceae

This family somewhat resembles the Grimmiaceae Family, but nearly always grows on trees. The plants are small, rarely reaching an inch in height and usually much shorter, blackish or brownish green below; nearly always growing in tufts or cushions. The leaves are oblong- or linear-lanceolate and usually very hygroscopic; cells of the upper part hexagonal to rounded-hexagonal, thick-walled and often papillose; lower cells oblong to rectangular, rarely papillose, thinner walled in most cases, and often hyaline; costa single, strong. The calyptra is nearly always hairy and the capsules often immersed, with very distinct longitudinal wrinkles when dry and empty. The peristome usually consists of 16 rather short teeth, which are nearly always reflexed when dry and are often united in pairs; the inner peristome is usually represented by 16 slender hairlike processes, often called cilia, but really homologous with the segments of the type of peristome found in *Mnium* and *Hypnum*. In some cases the peristome may be simple or even want-

ing, as in *Amphidium*. This family is often united with the *Grimmiaceae*, from which it is distinguished by the italicized characters. Members of these two families may become so dry and brittle as to crumble to dust in the fingers and yet retain their vitality unimpaired, springing into renewed growth with the next rain.

KEY TO THE GENERA

1. Calyptra smooth, cucullate; peristome none or very short and single; rock-growing except *Drummondia* 2.
 Calyptra mitrate, nearly always hairy; peristome well developed, almost always double; growing almost exclusively on trees 3.
2. Tree-growing; capsule long-exserted; peristome single, short and truncate. Common *Drummondia*.
 Rock-growing; capsule barely exserted; peristome lacking. Rare *Amphidium*.
3. Capsule exserted; leaves crisped, except *U. Americana* *Ulota*.
 Capsule immersed or emergent; leaves not crisped when dry *Orthotrichum*.

AMPHIDIUM (Nees) Schimp. (*Amphoridium* and *Zygodon* of authors)

Slender-stemmed dichotomously branching plants growing on rocks, usually in dense tufts from 3–8cm in depth, rather densely radiculose. Leaves linear to lance-linear, twisted and contorted to crispate; costa strong, reaching nearly to apex; upper leaf cells small, thick-walled, rounded or angular, said to be papillose but the papillæ are very low and inconspicuous; basal cells becoming gradually elongated-rectangular and thinner walled, also lighter colored or even hyaline. Calyptra cucullate, without hairs. Capsules erect, emergent or exserted, with a distinct neck, becoming urn-shaped and 8-striate when dry; peristome none.

The two species of this genus appear to be mainly alpine or subalpine in our range, and either rare or else sterile and seldom collected and identified. Both mature their spores in summer.

A. Lappónicum (Hedw.) Schimp. Monoicous, olive-green above, blackish or brownish below, seldom above 3cm in height; leaf margin plane throughout, basal cells thinner walled than in the next; perichætil leaves sheathing seta; seta 1.5mm long or less; capsule partially immersed, beak of operculum usually shorter than radius of capsule.

A. Mougeotii (B. & S.) Schimp. Dioicous, yellowish green, ferrugineous below, reaching 8cm in height; leaves longer and narrower than in the last, with borders narrowly recurved below, basal cells thicker walled than in the last and seta twice as long, sheathed only at base by the perichætil leaves; capsule usually exserted, beak of operculum longer than radius of capsule.

Limpricht remarks truly that this genus reminds one of *Rhabdoweisia* in appearance. Mr. Dixon says that *A. Mougeotii* is most likely to be mistaken for

Gymnostomum curvirostre or *rupestre*. This confusion is not likely to take place with fruiting plants, and the papillæ on the leaves of *Gymnostomum* are so much larger and more conspicuous as to afford a ready means of distinction. Besides, *Gymnostomum* usually grows on calcareous rocks, while *Amphidium* rarely does so.

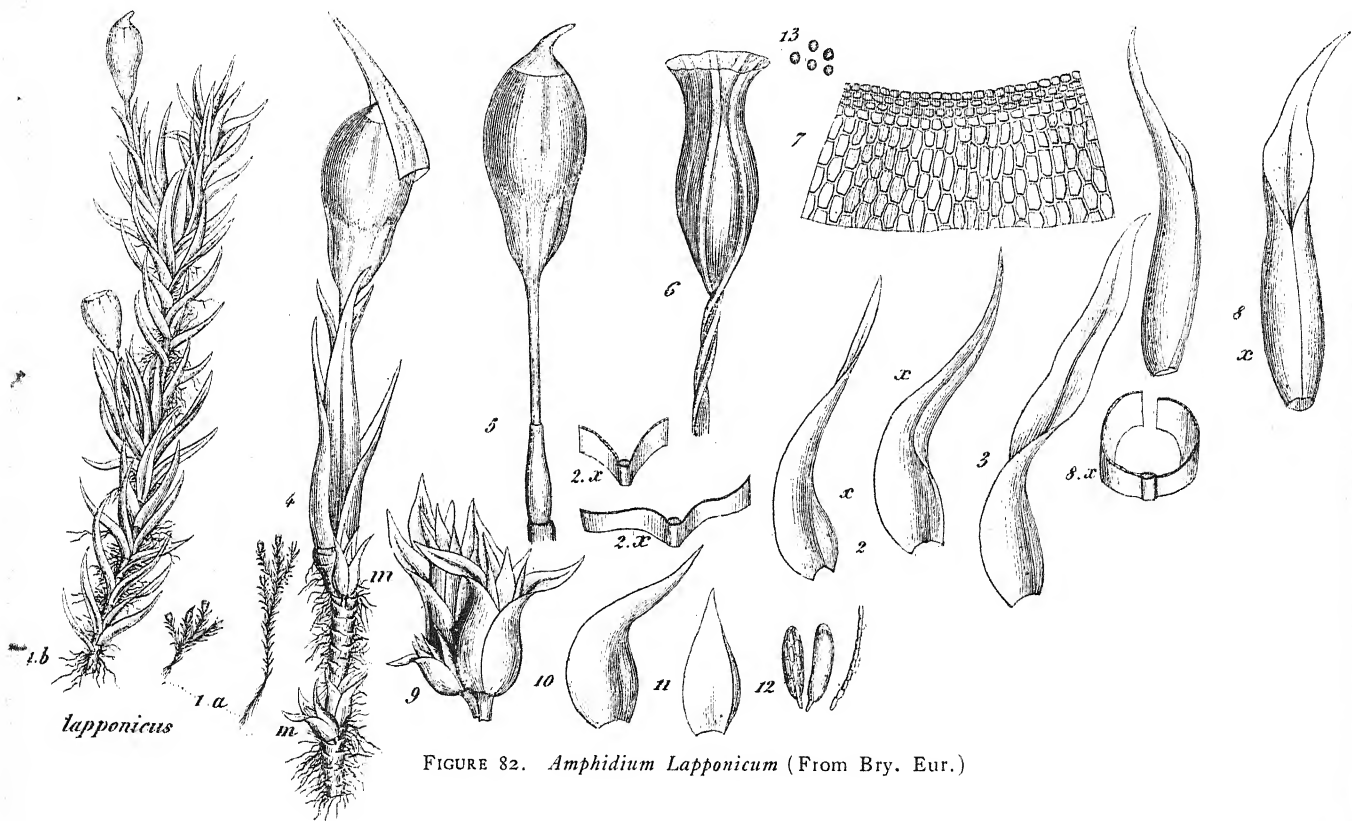


FIGURE 82. *Amphidium Lapponicum* (From Bry. Eur.)

DRUMMONDIA Hook.

Drummondia is a common moss of the *Orthotrichum* Family. It always grows on the bark of trees, but is easily distinguished from its tree-growing allies by three characters. Its stems are long and closely applied to the bark of the tree, sending out short horizontal branchlets so thickly that the stems below become apparent only when the plant is removed. The capsule is on a long seta, the calyptra is cucullate, and the peristome is so small as to be scarcely apparent.

Drummondia is named for Drummond, one of the earliest collectors of American mosses.



FIGURE 83.

Drummondia clavellata. a, $\times 1$. b, $\times 10$. c, Calyptra $\times 10$. d, Empty capsule $\times 10$.

D. clavellata Hook. is our only species. Its leaves are ovate-lanceolate, acute, entire; leaf-cells rounded and thick-walled, only slightly different at base, not papillose. The peristome is single, of 16 short truncate teeth, which look as if the upper three-fourths had been broken off.

ULOTA Mohr.

The species of *Ulot*a have the characteristic brownish-green or blackish-green color of the *Orthotrichum* Family. They are distinguished from all save *Orthotrichum* by the hairy calyptra. Both *Orthotrichum* and *Ulot*a grow on the bark of trees or more rarely on rocks, in cushions of varying size and thickness. The *Ulot*as growing on trees usually grow in more rounded tufts, with the leaves more crisped when dry than is usual with *Orthotrichum* growing in similar situations. The median basal leaf cells are often nearly linear, upper cells slightly papillose to smooth. The books all say that the hairs on the calyptra of *Ulot*a are flexuous, and those on *Orthotrichum* straight, but this distinction appears to be rather too fine for the amateur to profit by it. The capsules in both genera are erect and symmetric and quite regularly striate when dry, with eight or sixteen ridges and as many alternating furrows. These ridges consist of cells larger, darker, and thicker-walled than the alternating tissue. The peristome may be single or double. The seta in *Orthotrichum* is so short that the capsule is nearly always partially immersed; in *Ulot*a the seta is long enough to exsert the capsule entirely beyond the perichæatial leaves.

The remarks in the discussion of *Orthotrichum* on the condition of capsules suitable for study apply equally to *Ulot*a.

U. Ludwígii Brid., the Puckered *Ulot*a, has pear-shaped capsules, abruptly narrowed to the very small mouth; the ridges and furrows extend only a short distance from the mouth of the capsule, giving it the peculiar and characteristic appearance shown in the cut. The peri-

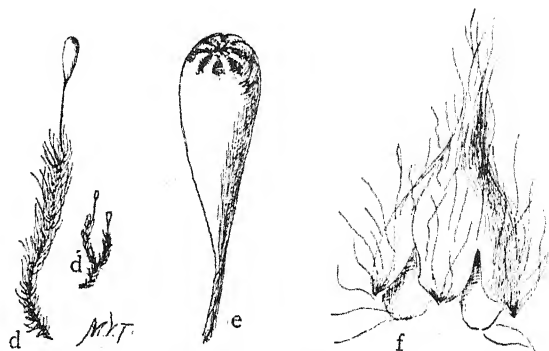


FIGURE 84. d, d'. *U. Ludwígii* $\times 4$ and $\times 1$ respectively. e, Capsule $\times 20$. f, Calyptra of mature capsule $\times 21$.

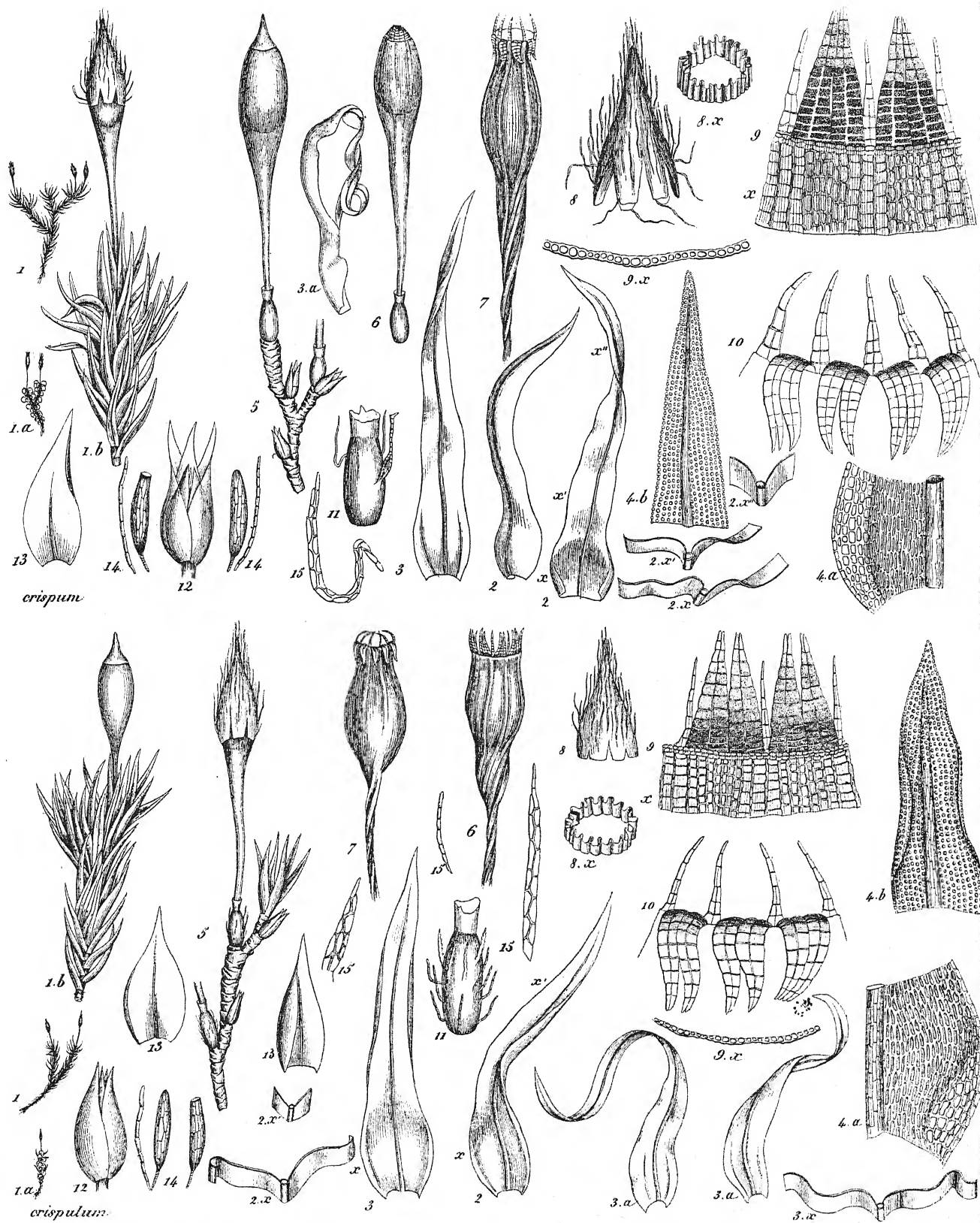


PLATE XXXVIII. *Ulota crista* and var. *crispula* (From Bry. Eur. *Orthotrichum crispum* and *crispulum*.)
 3a. Dry leaves. 8x. Cross section of calyptra. 7. Dry and empty capsules.

stome teeth are erect when dry, united in pairs; inner peristome imperfect or wanting. The marginal cells at the base of the leaves have thin longitudinal walls and form a narrow hyaline marginal band tapering upwards to the top of the leaf-base. Spores in autumn.

U. crispa Brid. The capsules of the Crisped *Ulota* have a much larger mouth, are striate for the entire length and are contracted under the mouth when dry and empty. The peristome teeth are united in pairs and at first are spreading, later recurved; segments 8 or rarely 16. The seta is shorter, the color is lighter, and the tufts are rather thicker than in the Puckered *Ulota*. The leaves resemble those of that species, but have a wider marginal band of hyaline cells at base. In the not uncommon variety *crispula* of the Crisped *Ulota* the capsule is much shorter and is suddenly contracted into a neck, narrow and much twisted when dry. The capsule is scarcely contracted under the mouth except immediately after the fall of the operculum; when very old it may taper uniformly to the seta. The spores are ripe in late spring and early summer.

U. Bruchii Hornsch. is an alpine or subalpine species, rather rare, larger and with leaves less strongly crisped than in the last. The seta is longer, and when the capsules are dry and empty they become distinctly fusiform, gradually narrowed to the mouth but not contracted beneath it.

The cut gives an excellent idea of the progressive changes in the capsules. Sometimes all the forms illustrated may be found in the same tuft. This species is occasionally found on rocks. The spores mature in summer.

U. Americana (Beauv.) Lindb., the American *Ulota*, grows exclusively on rocks. Its leaves are rigid when dry like those of *Orthotrichum*, not crisped as in the two tree-growing species; the capsules very closely resemble those of the Crisped *Ulota*, except that the seta is markedly longer. It is most likely to be confused with *Orthotrichum anomalum*. For distinctions, see under that species. All of these species of *Ulota* except *Bruchii* are common in the hilly portions of our range, and the tree-growing species with *Orthotrichum* furnish good collecting for winter and early spring, when most other plants are buried under snow.

ORTHOTRICHUM Hedw.

Plants comparatively short-stemmed, in close rounded cushions, sometimes looser, on trees

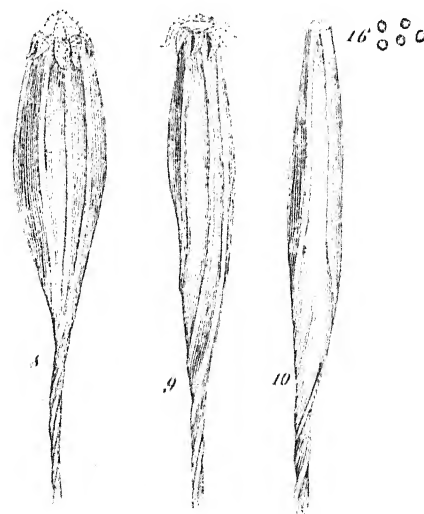


FIGURE 85.

Three capsules of *Ulota Bruchii*, showing progressive changes due to increasing age. (From Bry. Eur.)

everywhere, and more rarely on rocks. Leaves hygrosopic, imbricated when dry and not greatly curled or twisted, which character separates the genus from *Ulot* except *U. Americana*. Upper leaf cells usually papillose, thick-walled, the lower thinner-walled and quadrate to rectangular. Calyptra sparsely hairy or naked. Base of seta enclosed in a minute cup-like sheath, the ochrea. Capsule immersed or emergent, rarely exserted; usually with 8 regular folds, or plicæ, when dry, but sometimes smooth or with 16 plicæ. Peristome usually double, with 16 broadly lanceolate teeth, which are usually united in pairs. Inner peristome of 8-16 narrow segments, often called cilia. The paired (bigemminate) teeth and degenerate inner peristome illustrate well the degeneracy of peristomes on erect capsules.

The *Orthotrichums* are most frequent on trees about houses, and in orchards and village streets, although they are not lacking in other situations where the trees stand somewhat apart. They can be found abundantly on almost any fruit or shade tree in the country. In the larger cities, for some reason, they do not seem to thrive. They may frequently be found growing with *Ulot*, from which the immersed or emergent capsule and non-cripsed leaves distinguish them at once. One common species (*O. anomalum*) grows on rocks. The calyptras are less densely hairy than those of *Ulot*. Two species have a calyptra without hairs. The leaves have revolute margins, except in *O. obtusifolium*, which appear as a darker margin when the leaves are mounted on a slide. *Drummondia* has the general appearance of an *Orthotrichum* with an exserted capsule, but the calyptra is cucullate and without hairs and the capsule is not wrinkled when dry.

This is a difficult genus, usually avoided by the amateur, but I believe one can learn to recognize all the common species with a hand-lens when they are well fruited; it will usually serve to determine the number and position of the teeth, markings of the capsules and general outlines of the leaves. Sterile specimens are often indeterminable. The stomata furnish an excellent and definite microscopic character and are easily observed by separating a capsule into two or more divisions with the dissecting needles and mounting outside up; the stomata are nearer the middle of the capsule than in many mosses and are, therefore, easier of observation. The condition of the material is of the utmost importance. The capsule must be thoroughly soaked in hot water for a long time to be fully expanded, and the dry capsule must be thoroughly dry to be characteristic. The capsules of all species shrink progressively with increasing age, and many varieties had their origin in this fact. The plants should be moistened to determine whether the capsules are immersed, emergent, or exserted. The peristomes are often quite brittle and are apt to be broken, especially the segments. For identifying species, especially with a hand-lens, perfect calyptras are of the greatest value and importance.

KEY

1. Rock-inhabiting species; peristome single, teeth 16, erect or erect-spreading on dry capsules; stomata immersed 2.
Tree-inhabiting species; peristome double, teeth usually united into 8 pairs, re-curved or reflexed when dry 4.
2. Capsule fully exserted, 16-striate *anomalum*.
Capsule immersed or emergent, 8-striate 3.
3. Capsule ovate-cylindric, urn half emergent when dry *Porteri*.
Capsule much shorter, ovate-globose, leaves nearly reaching mouth of urn when dry *Lescurii*.
4. Stomata superficial (*i. e.*, with both guard-cells on the surface. See plate 39, figure 13) 5.
Stomata immersed. (See figure 87, 10) 8.
5. Leaves obtuse (rarely with some leaves acute), broad pointed, margins plane . . . *obtusifolium*.
Leaves acute, margins revolute or involute 6.
6. Capsule almost or quite exserted, smooth, or very slightly plicate around the mouth when dry and empty *speciosum*.
Capsules immersed or slightly emergent, plicate the whole length when dry . . . 7.
7. Empty capsule strongly contracted below the mouth when dry, neck immersed; common *sordidum*.
Empty capsule less strongly contracted, exserted; rare *affine*.
8. Capsules strongly contracted under the mouth when dry, and so strongly plicate that the red-brown folds are in contact on the outside when dry and empty . . *strangulatum*.
Capsules very slightly or not at all contracted, much less strongly plicate, pale, whitish or yellowish 9.
9. Leaves entire, blunt at extreme apex *Ohioense*.
Leaves (some at least) dentate with projecting cells, often apiculate 10.
10. Leaves mostly acute at apex, not rounded; usually some with an apiculus of a single projecting cell; capsules plainly 8-plicate when dry *Schimperii*.
Leaves obtuse, rounded and some sharply denticulate at apex with several projecting cells; capsule smooth or faintly 8-plicate when dry *pusillum*.

O. anomalum Hedw. In rather dense cushions, dark olive-green or brown below; leaves ovate-lanceolate, papillose with small simple papillæ; basal cells rectangular, *thin-walled and hyaline*; calyptra hairy; capsule usually fully exserted, 16-striate, the 8 intermediate folds less distinct, oval-cylindric when moist, cylindric when dry, abruptly narrowed to the neck; stomata immersed; peristome erect when dry, of 16 teeth, usually separate, with preperistome (*i. e.*, with two short lamellæ before each tooth reaching as high as the second or third articulation); segments none or rudimentary. Spores maturing May-June. Not rare.

Mrs. Britton says that we also have the var. *saxatile*, which has narrower 8-striate capsules with teeth united in pairs, and 8 well-developed segments.

This species will not be confused with any other species of *Orthotrichum*, but may be confused with *Ulota Americana*. The latter has the dry capsule gradu-

ally narrowed into the long neck and the teeth *reflexed* when dry and united in pairs, and the basal leaf-cells are thick-walled and colored; besides, it is almost black in color except at the extreme ends of the stems and branches, and grows in loose wide mats. Its spores mature much later, July–September. *Drummondia* has the general appearance of an *Orthotrichum* with an exserted capsule, but it grows on trees only.

O. Porteri Aust. and *O. Lescurii* Aust. are our only other rock-inhabiting forms, at least the only ones at all likely to be met with. They have usually been treated as varieties of *O. cupulatum* Hoffm., but both Dr. Venturi and Mrs. Britton consider them distinct, and Mrs. Britton says that we have no *cupulatum* in the Eastern States. These two forms have not been frequently collected or adequately described. Their habitat and immersed or emergent capsules should serve to identify them, and collectors should be on the lookout for them.

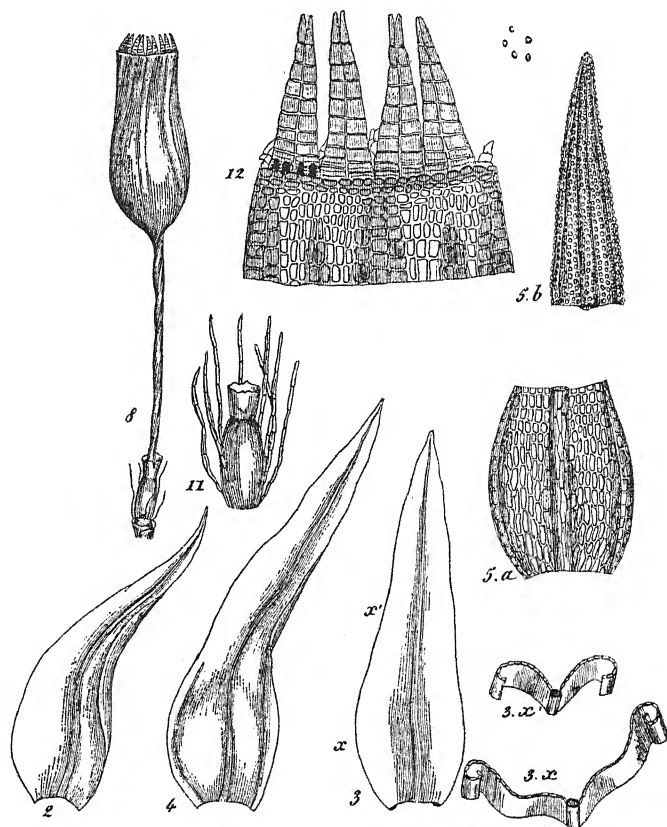


FIGURE 86. *Orthotrichum anomalum* (From Bry. Eur.).

2, 3, 4 and 5. Leaves; x and x' indicate where the sections $3x$ and $3x'$ were made. 11. Vaginula. 8. Deoperculate capsule and seta. 12. Peristome highly magnified; the tooth at the left has been redrawn to show the lamellae of the preperistome.

Dr. Venturi stated in a letter to Mrs. Britton that *O. Porteri* had a distinct preperistome as in *O. anomalum*, but he is the only one who has noted it, and other observers have failed in their attempts to verify his observations.

O. Ohioense S. & L. In rather dense, small cushions, yellowish green, brown below; stems about 1 cm long; leaves oblong-lanceolate, blunt at the apex or obtusely acute, papillose; calyptra hairy; moist capsule immersed, oblong-ovate, when dry slightly 8-plicate, campanulate, becoming more narrowed with age, straw-colored; peristome of 8 double teeth, strongly reflexed when dry; segments shorter than the teeth, of a double row of cells, except at apex;

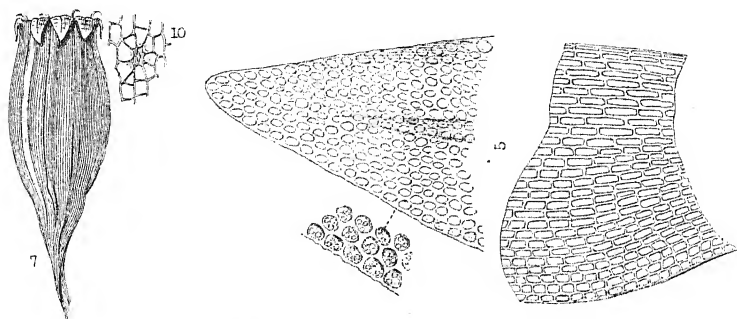


FIGURE 87. *O. Ohioense* (Sulliv. Icones Musc. Suppl.) 5. Areolation of leaf. 7. Dry and empty capsule. 10. Stoma.



FIG. 88. Capsule of *O. strangulatum*.

entire leaves serve to distinguish it from the other species with light-colored capsules.

O. strangulatum Sulliv. This is one of our most common mosses, abundant on shade trees almost everywhere. It can be recognized with a hand-lens by the characters given in the key if one is familiar with it. The capsules are not so deeply plicate until a month or more after the spores ripen. It is a little smaller than the preceding, the leaves are narrower, and the calyptra naked and strongly plicate; the spores apparently mature about a month later. The first few rows of cells around the mouth of the capsule in this species have nearly quadrate cavities, while in the preceding these cavities are nearly circular.

Dr. Best is of the opinion that the form figured here is at least a good variety and not the true species. The capsule figured by Sullivant (Icones Musc. pl. 36) has a shape intermediate between that shown here and that figured for *O. Ohioense*. The form shown in Fig. 88 is the common one in northern New England.

spores maturing in early spring (April). Common on trees. When sterile it is a difficult matter to distinguish this from the next, but the straw-colored lightly plicate capsules are easy of recognition and the

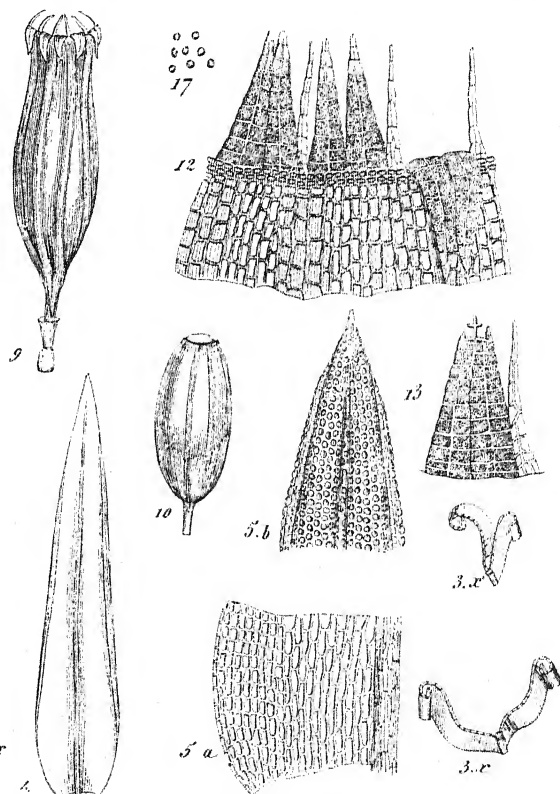


FIGURE 89. *O. Schimperi* (From Bry. Eur.) 3, 4 and 5. Leaves. 9, 10, 12 and 13. Capsules and peristome.

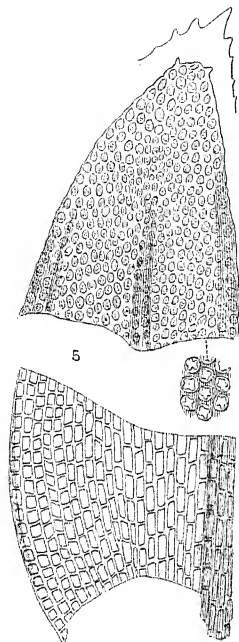


FIGURE 90.

Leaf structure of
O. pusillum (Sulliv.
Icones Musc. Suppl.)

brachytrichum Schimp. is a synonym for the American form of this species, and that we have no true *O. Schimper*.

O. pusillum Mitt. (*O. psilocarpum* James.) The plants are as small as those of the preceding and the color is blackish green, but the capsules are ovoid or globose when moist, only faintly ribbed even when old. Spores maturing in May. Apparently not common. The apex of the leaves is very characteristic as figured. It is very like *O. Schimper* except in the characters mentioned here and in the key.

O. obtusifolium Schrad. Yellowish green, about an inch high;

O. Schimper Hamm. (*O. fallax* Schimp.) In short, close, dark green tufts, only a few mm. high; leaves oblong-lanceolate, obtuse or usually some acute and ending in an apiculus of a single elongated cell, leaf cells rather large and thinner-walled than usual in the genus, papillose; calyptra with a few short hairs; capsule small, immersed, oblong-ovoid, light-colored, when dry narrow and slightly contracted below the mouth, with 8 rather prominent plicæ; teeth 8, reflexed, densely papillose; segments 8; spores maturing in spring. Frequent.

A specimen with all the leaves obtuse might be mistaken for *O. Ohioense*, but the smaller size, darker color and smoother calyptra are quite pronounced. The form with the leaves narrowly acute and apiculate and narrower capsule has been called var.

truncatulum by Austin. Rarely the leaves have more than a single projecting cell at the apex. Mrs. Britton and Dr. Best think that *O.*

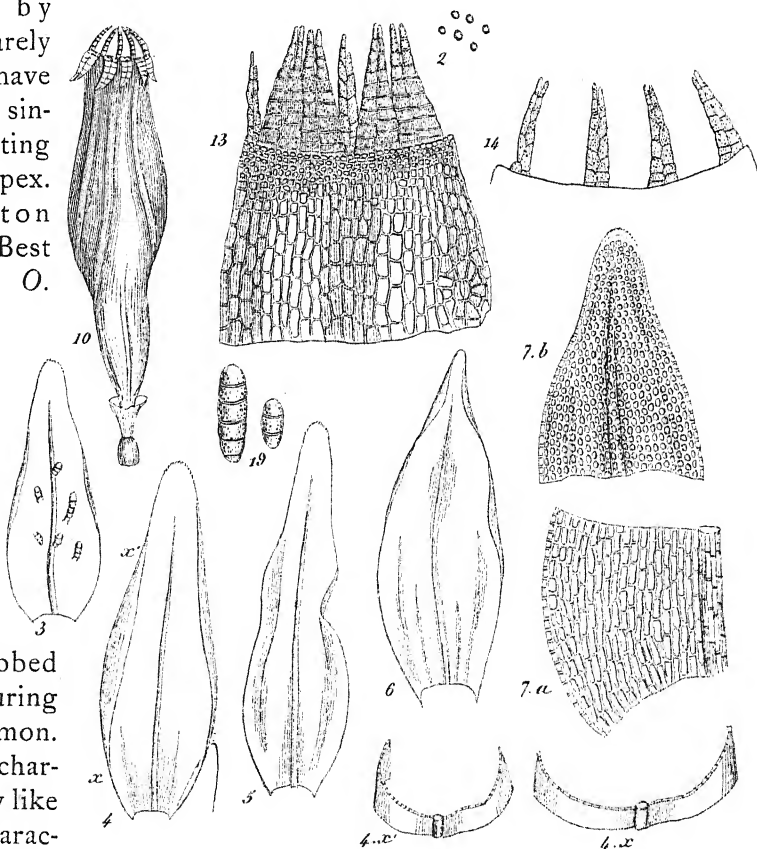


FIGURE 91. *O. obtusifolium* (From Bry. Eur.)

3, 4, 5 and 6. Leaves from below upwards. 7. Shows cellular structure of leaf. 10. Capsule. 13. Peristome highly magnified. 14. Segments of the same. 19. Propagula.

leaves short and very broad, oblong-ovate, *very broad and obtuse at apex, papillose, margin not appreciably revolute or incurved*; calyptra naked, *not at all plicate*, brownish at the tip, lighter colored below; capsule immersed, with 8 plicæ when dry; peristome double.

Probably a very common species, but so seldom fruiting as to be collected infrequently. The leaves usually bear clavate, septate propagula, which may account for the rarity of the fruit. The broad apex, entire except for papillæ, and erect margins, render sterile specimens easy to determine. All other species have the margins revolute or involute. *O. gymnostomum* Bruch has been found in Newfoundland. It is closely related to this species but has *involute* leaves and no peristome. Collectors should look out for it.

O. speciosum Nees. Perhaps the largest of our species, two to four cm. in height, yellow-green above; leaves tapering, *very acute*, papillose; *leaf cells very thick-walled*, the upper circular or elliptical; calyptra large, hairy, campanulate; capsule oblong-cylindrical, almost exserted, the upper leaves barely

reaching the base, smooth or barely marked with irregular ridges when dry; operculum rostellate; peristome of 8 teeth, which when dry are recurved rather than reflexed, as the tip of the tooth sometimes touches the capsule wall in a way to remind one of the handle of a mug; segments 8, papillose. Like *O. obtusifolium*, this species occurs rarely on rocks. The spores mature by October, but I have collected operculate capsules in March.

O. sordidum S. & L. Somewhat resembles the preceding in leaf characters, but the leaves, though acute, are broader pointed, with thinner cell-walls. It is at once distinguished by the immersed or emer-

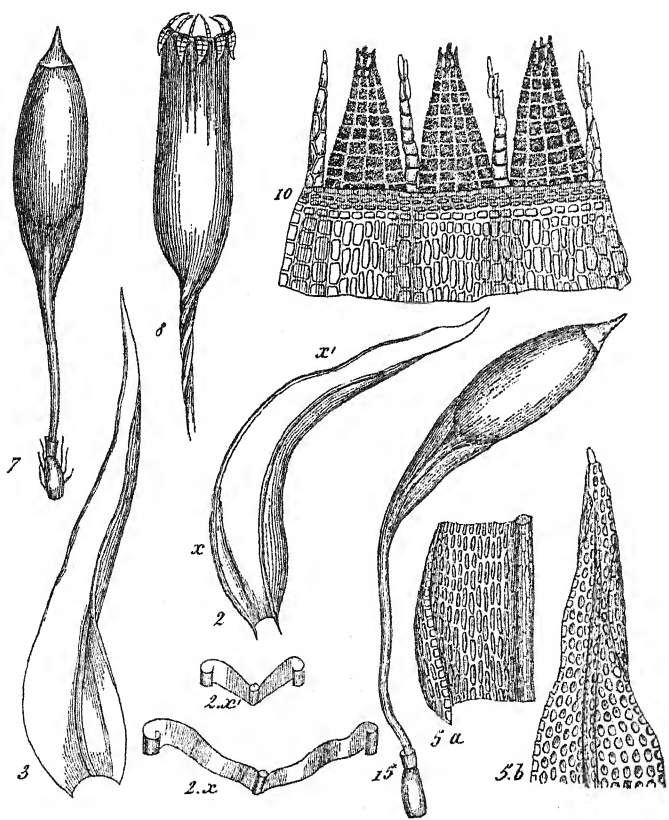


FIGURE 92. *O. speciosum* (From Bry. Eur.)

2, 3 and 5. Leaves. 7, 8, 10 and 15. Capsules and peristome.

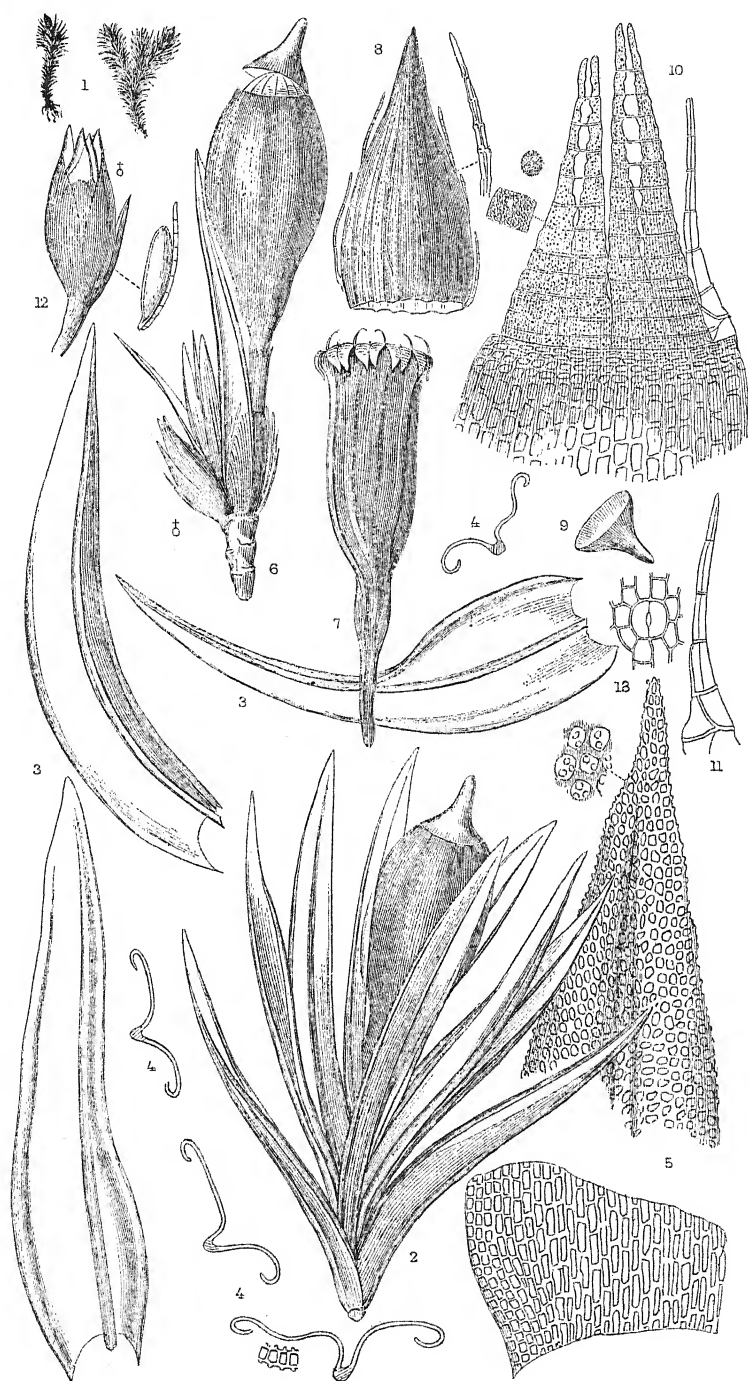


PLATE XXXIX. *O. sordidum* (Sulliv. Icones Musc. Suppl.)

1. Plants natural size. 2. Leaves. 3. Leaves. 4. Leaf sections. 5. Cellular structure of leaf base and apex. 6. Antheridial branch with antheridium and paraphysis. 7. Segment of peristome highly magnified. 8. Superficial stoma. The other figures are self-explanatory.

gent plicate capsules and smooth segments. The spores mature in late spring or summer.

This species is so close to the var. *fastigiatum* of *O. affine* that it may cause confusion, especially as the teeth of *sordidum* are often as markedly trabeculate at the summit as those of *fastigiatum* figured by Limpricht (Laubmoose 2:82), but both *affine* and its var. are rare. I have not been able clearly to differentiate *sordidum* from *affine*, and incline to the opinion that they are forms of the same species for all except the experts. All our ordinary forms are *sordidum*, however. *O. affine* is certainly treated differently by European authors and is exceedingly variable. The capsule of *sordidum* is often so strongly contracted under the mouth as to resemble *strangulatum*, except for the larger size of the plant and the lighter color of the capsule.

O. striatum (L.) Hedw. (*O. leiocarpum* B. & S.) is a rare species, with capsule almost as smooth as in *O. speciosum*, and it has been confused with it by several good bryologists, but the capsules are *immersed* or only slightly emergent and ovoid; teeth 16, *separate*, segments 16, comparatively broad.

In August I have found *O. speciosum*, *O. sordidum*, *O. strangulatum* and *O. Ohioense* growing together on fruit trees. *O. strangulatum* is much the most abundant, and is easily recognized by the strangulate, dark red-brown capsules appearing as described in the text. *O. Ohioense* is about the same size, but the straw-colored capsules catch the eye at once. *O. sordidum* stands out at once by reason of its greater size and larger leaves and capsules less plicate than in *O. strangulatum*. *O. speciosum* is somewhat smaller than *sordidum*, and at this time the capsules are immature, with the hairy calyptra still firmly attached. The comparative sizes of *speciosum* and *sordidum* are just the reverse of what my herbarium specimens and the book descriptions led me to expect, as the specimens of *speciosum* I collected were much smaller than those in my collection.

Visiting these same trees in April, I found *O. obtusifolium* abundant and readily distinguished by its naked non-plicate calyptra, while the naked calyptra of *O. strangulatum* was regularly and deeply plicate. At this stage these species were readily distinguished from each other and all the other intermingled species by the naked eye alone.

Family 13. Schistostegaceae

Schistostega osmundacea (Dicks.) Mohr., the Luminous Moss, belongs in a family all by itself because of its numerous peculiarities.

The plants are very small and slender. The sterile plants have the leaves distichous and ecostate with their bases confluent. Those of the fertile plants

are arranged in a tuft at the top of the stem; the leaf-cells are lax and rhomboidal in shape. The capsules are very small and without peristome; they are sparingly produced and ripen in spring. It is found in caves and dark holes in the woods, sometimes under the roots of overturned trees. It has once been found under the sill of an old shed.

On looking into one of these caverns containing the Luminous Moss, the bottom seems covered with a golden-green glow, something like the appearance of a cat's eyes in the dark. In order to see the glow one must look into the cave in the direction from which the light enters, and care must be taken not to shut off all the entering light, as the Luminous Moss, like the moon, shines by reflected light alone. If one attempts to gather the glowing substance he will find nothing but dirt and stones, with possibly a few tiny green plants like those in the figure. The compound microscope will reveal threads like those shown in the plate, but the lens will show only a cobwebby appearance of fine green threads. This beautiful plant is probably the reality upon



FIGURE 93. *Schistostega osmundacea* (From Bry. Eur.)
1 and 2. Plants natural size. 29. Protonema as it appears
under the compound microscope.

which are based the fairy tales of goblin gold. The discovery of this rare and curious plant will repay a search in every dark hole one sees. If present, it can always be seen from the outside, as it cannot grow beyond the reach of light. Mrs. Britton's Observer articles give a much fuller account of this moss.

Family 14. Splachnaceae

The mosses of this family are rather short-stemmed with leaves distant and flaccid, with a loose areolation, not papillose. The calyptra is cucullate, or entire and conical. Capsules erect and symmetric, with a very pronounced and

characteristic hypophysis, which in some species is so exaggerated as to become a striking natural curiosity. The peristome is single in all our species, but is often constructed of three layers with a cellular cavity between two of them so that it is probable that the inner peristome is merely coincident with the outer and adherent to it. The teeth are often united in pairs or more rarely in fours, much as in *Orthotrichum*, and are sometimes reflexed as in that genus. The hypophysis is well supplied with stomata and is made up of loose tissue well adapted for the assimilation of carbon dioxide.

The mosses of this family nearly all grow upon decaying animal tissue or upon animal excreta, more rarely upon decaying vegetable matter, and this, taken in connection with the peculiar hypophysis, makes fertile plants unmistakable. The flaccid leaves, with their loose areolation, distinguish sterile forms from most mosses except, perhaps, the *Funariaceæ* and *Meesiaceæ*.

KEY TO THE GENERA

- Hypophysis not very much broader than the rest of the capsule *Tetraplodon*.
Hypophysis greatly inflated *Splachnum*.

SPLACHNUM L.

The exceedingly large hypophysis and the obovate or broadly lanceolate leaves widest above the base, considered with the family description, sufficiently characterizes the genus. There are several species of *Splachnum*, but only one is likely to be found.

S. ampullaceum L., the odd-looking moss represented in Fig. 94, is not very common and will not be found readily by most students. It is so striking in appearance that no one can fail to recognize it. The spores are borne in the slender upper portion; the swollen and colored (lilac or purplish) lower portion is the hypophysis of the capsule, which is covered with stomata and filled with loose tissue suitable for the assimilation of carbon dioxide. When dry this portion becomes irregularly shrunken in a manner very difficult to represent in a drawing.

The plants are 1-2^{cm} in height, usually longer than those figured. The leaves are rather distant, the lower lanceolate, the upper narrowly obovate with a slender apex, as shown in the figure; all are serrate, with the costa percurrent or nearly so. The spores mature in summer.

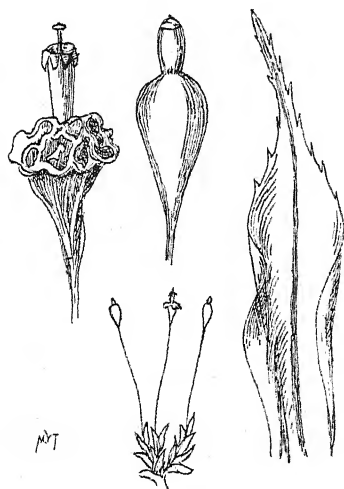
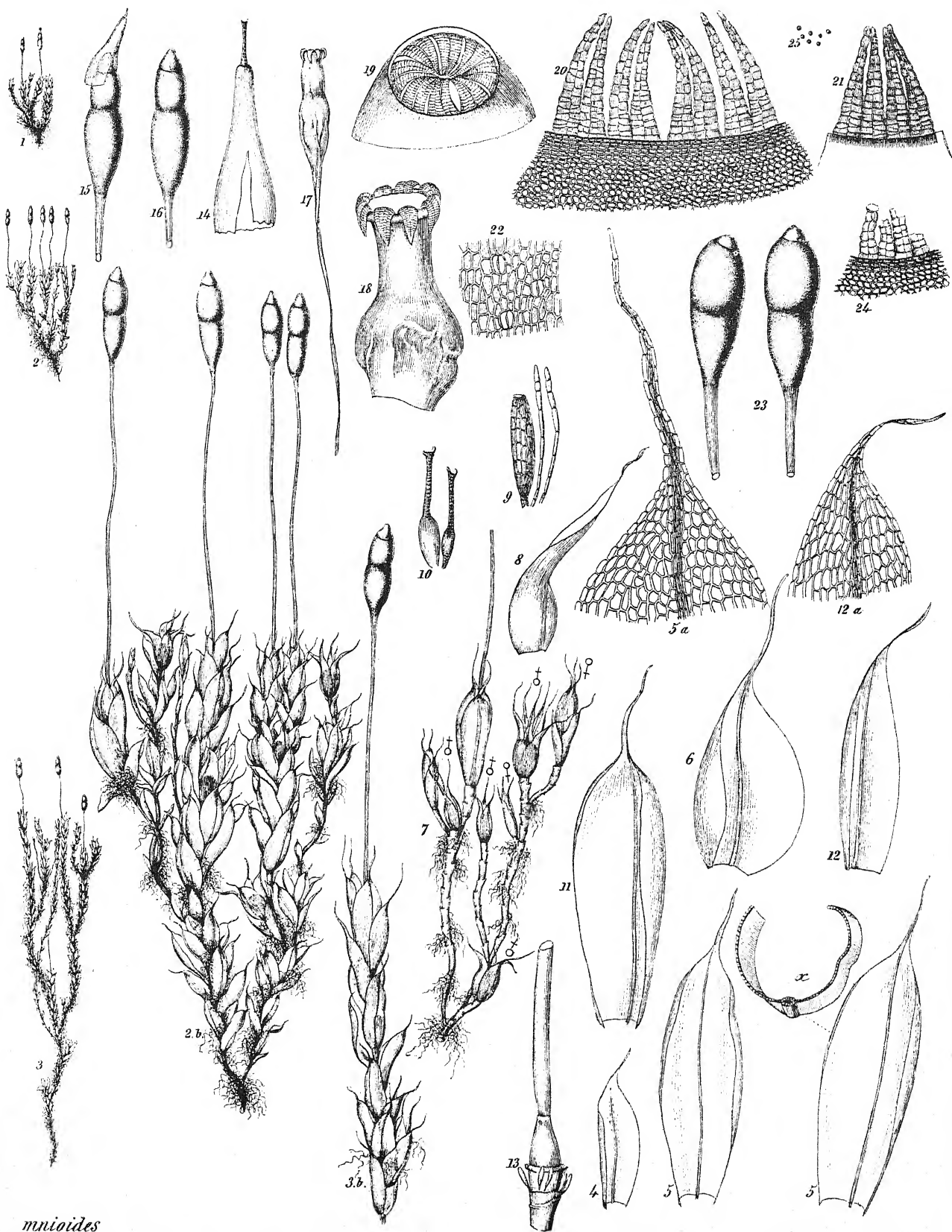


FIGURE 94.

Splachnum ampullaceum; leaf $\times 10$; capsule, ripe and unripe $\times 5$.
(The plant and capsules represented are rather small, as they are often found of twice this size.)



mnoides

PLATE XL. *Tetraplodon bryoides* (From Bry. Eur. *Splachnum mnoides*.)
22. Stomata from capsule wall.

This species is widely distributed in swamps throughout our region, but is rather rare. When found, it is often growing on cow dung.

S. luteum Mont. is a very rare species with an enormous yellow umbrella-shaped hypophysis.

S. rubrum Mont. is another very rare species with a similar purple hypophysis.

TETRÁPLODON B. & S.

Resembling *Splachnum* but with a much smaller hypophysis of the same color as the rest of the capsule and with the leaves narrower as a rule, although *T. bryoides* is an exception to this last.

KEY

- | | |
|---|---------------------|
| 1. Leaves elongated-lanceolate, strongly serrate | 2. |
| Leaves ovate-lanceolate to obovate, entire | <i>bryoides</i> . |
| 2. Leaves sharply serrate, narrowed to a filiform point | <i>angustatus</i> . |
| Leaves incised serrate, acuminate with a broader apex | <i>australis</i> . |

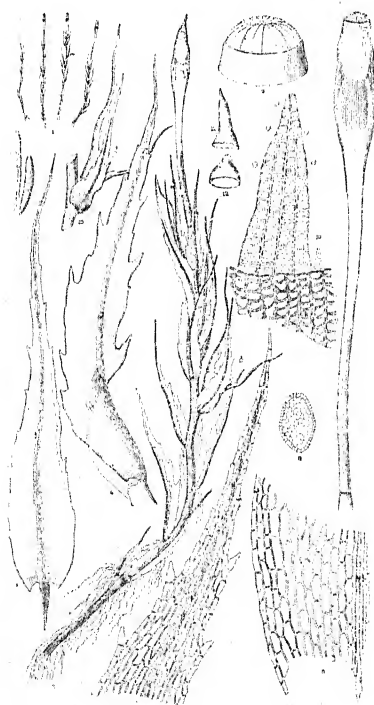


FIGURE 95.

Tetraplodon australis (From Sulliv. "Icones." Reduced $\frac{1}{2}$). 1. Plants $\frac{1}{2}$ natural size. 8. Cross section of seta.

T. bryoides (Zoeg.) Lindb. (*T. mnioides* B. & S.). This is probably the most abundant species of the family within our range, although it is confined to the tops of our higher mountains. It is densely tufted, two to eight cm. high; leaves concave, entire, ovate-lanceolate to obovate, tapering into a long filiform point of which the costa forms the greater part; marginal leaf cells often narrower and yellowish. Spores in summer. I have collected this on hedgehog bones back of the hotel on Mt. Mansfield, Vt., and it has been several times collected around the stables of the hotel on Mt. Washington, N. H.

T. angustatus (L. fil.) B. & S. is another much rarer alpine species, with lanceolate serrate leaves having a very long filiform point like that in the previous species. The seta is much shorter, the capsule being only slightly exerted.

T. australis Sulliv. & Lesq. is not an alpine plant but occurs in swamps along the coast from New Jersey southward. It has once been found as far north as Nova Scotia, so that col-

lectors should be on the lookout for it. The distinctive characters of the species are well shown in the illustration. The leaves are long lanceolate and incised-serrate, sometimes almost pinnatifid; costa percurrent. The hypophysis is only a little broader than the rest of the capsule, or frequently reduced to merely a small neck; the columella is often exserted and the teeth reflexed; the spore-bearing part of a freshly opened capsule is a brick-red and the teeth a brighter shade of the same color; the seta is rather short as in *T. angustatus*, which it somewhat resembles, but the leaves are very much more deeply toothed as a rule, although they are sometimes entire. The difference in habitat is, however, most distinctive.

TAYLÓRIA Hook.

is another genus of this family of which a few very rare species are found in northeastern America. The hypophysis is much smaller than in the two preceding genera, being narrower than the rest of the capsule and appearing as a neck. *T. tenuis* (Dicks.) Schimp., having widely spatulate serrate acuminate leaves costate nearly to apex, is the species most likely to be found. It has been collected as far south as Mt. Mansfield, Vt.

Family 15. Funariaceae

Plants annual, sometimes biennial, growing on soil that is bare or sparsely covered with other vegetation, rather short, with large wide soft leaves much like those of the last family, having a strong costa extending, in most cases, well toward the apex. The leaf cells are parenchymatous, large and thin-walled, elongated hexagonal to oblong above, usually rectangular at base. Capsules subglobose, ovoid, or pyriform, erect and symmetric, or strongly unsymmetric and sometimes cernuous, usually with a distinct neck. Peristome lacking or single or double. The teeth when present are 16, and the segments are opposite the teeth instead of alternate with them as in *Mnium* or *Hypnum*. There is no basal membrane or intermediate cilia. Calyptra often inflated, usually with a long beak, cucullate or often split in two or more places.

KEY TO THE GENERA

1. Capsules erect and symmetric; peristome lacking 2.
 Capsules strongly unsymmetric; peristome present, usually double . . . *Funaria*.
2. Capsules exserted on a long seta *Physcomitrium turbinatum*.
 Capsules immersed 3.
3. Capsule splitting exactly in the middle, with no specially modified cells
 along the line of dehiscence; angles of cell-walls of capsule thick-
 ened (collenchymatous) *Aphanorhegma*.
 Capsule dehiscing by a regular lid having 1-3 rows of denser cells around
 its mouth; cell-walls of capsule not thickened at the angles . . . *Physcomitrium immersum*.

APHANORHÉGMA Sulliv.

A small genus of only two known species. It seems to differ from *Physcomitrium* chiefly in the much less differentiation of the tissues along the line of dehiscence of the capsule.

A. serratum Sulliv. Plants whitish green, growing more or less thickly clustered. Monoicous, with antheridia in the axils of the leaves or rarely mixed with the archegonia. Lower leaves smaller and more open; upper larger and more nearly erect, oblong to spatulate-lanceolate; costa almost percurrent; capsule immersed, splitting almost exactly half way between seta and apex; cells immediately below the line of dehiscence slightly elongated transversely but not otherwise differentiated. Cell-walls of capsule thickened at the angles (collenchymatous), easily distinguishing this from *Physcomitrium immersum*, which it closely resembles. The spores mature from September to December. On damp soil, apparently preferring clay, frequent in our range except in northern New England.

PHYSCOMÍTRIUM Brid.

Mostly small light green plants, sparingly branching. Leaves oblong, obovate, spatulate or broadly oblanceolate. Calyptra small, mitrate, usually covering less than $\frac{1}{2}$ the capsule. Capsule on a long seta, in a few cases immersed, erect, symmetric, with a distinct lid but no peristome; annulus present, often persistent.

P. immersum Sulliv. is a widely distributed but rather infrequent species so much like *Aphanorhegma serrata* that it is often mistaken for it. It is, however, readily distinguished by the characters mentioned under that species and in the key, and by the fact that the antheridia are at first terminal on the young plants and later become lateral by the growth of innovations bearing archegonia. This is the only one of our species of the genus which matures its spores in the fall.

P. turbinatum (Mx.) Brid., the Common Urn-moss (*P. pyriforme* of the L. & J. Manual, not of Bridel). Plants exceedingly variable according to the conditions under which they develop, as Mrs. Britton has shown (Journ. of N. Y. Bot. Garden 4: 50. 1901. Also, see Bryologist, 4: 50. 1901.) Autoicous, 3–12^{mm}. in height, leaves 3–5^{mm} long, oblanceolate or obovate from

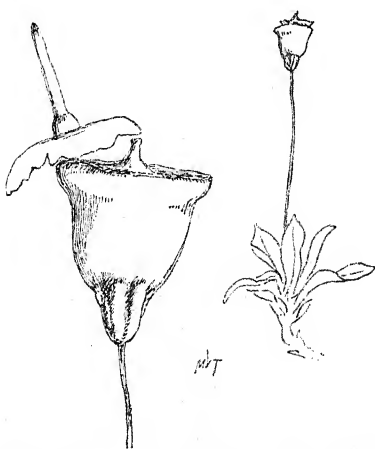


FIGURE 96. *Physcomitrium turbinatum*
× 4; capsule × 15.

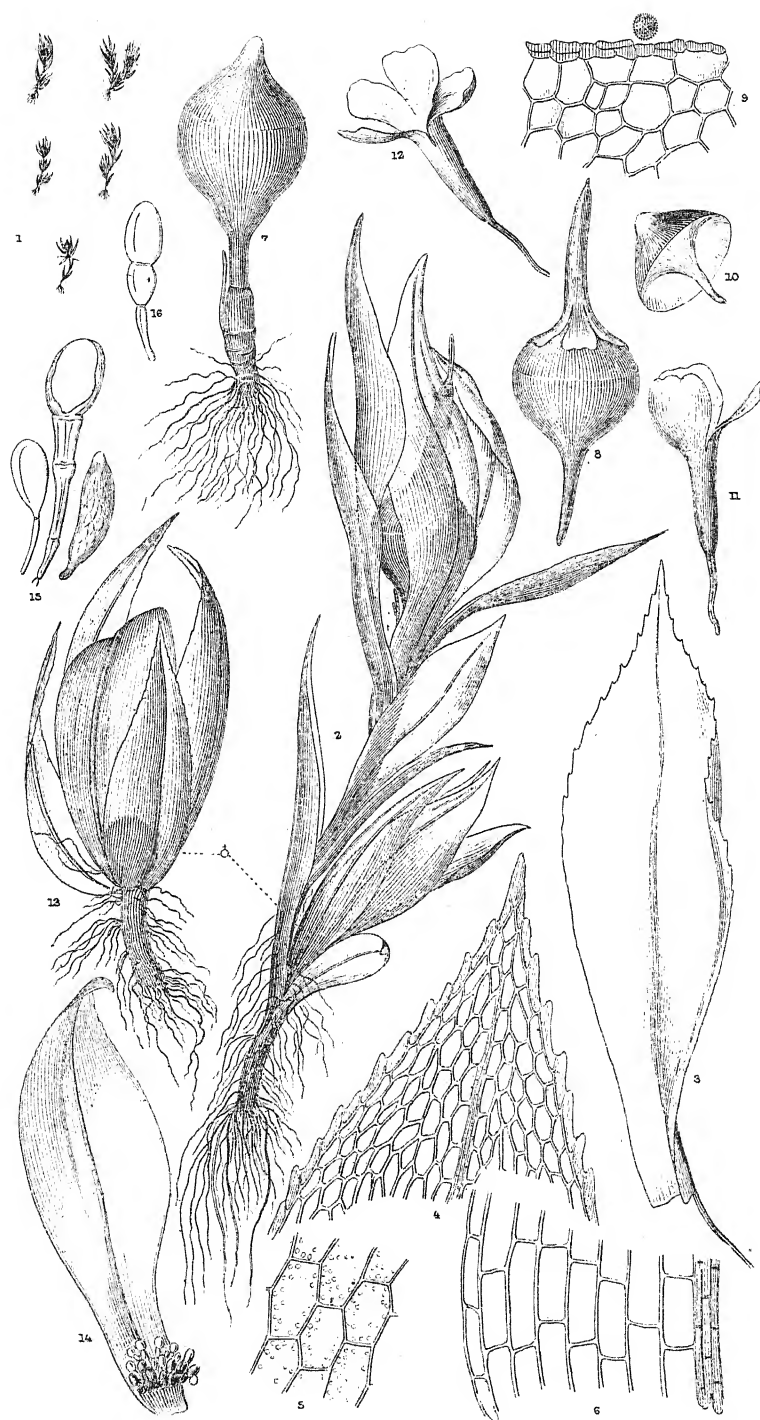


PLATE XLI. *Physcomitrium immersum* (From Sulliv. "Icones")

an oblong base, serrate above the middle, costa ending below the apex or rarely excurrent in some of the leaves. Capsules globose-pyriform when fresh, becoming turbinate and constricted below the mouth when dry, dark brown and often urn-shaped when empty; mouth bordered by 8-12 rows of transversely elongated cells; annulus persistent and incurved after falling of the lid. Spores rough, maturing in spring. (Description adapted from Mrs. Britton's "Revision of the Genus *Physcomitrium*," Bull. Torr. Bot. Club. 21: 199. 1894.)

The Common Urn Moss is common on earth in conservatories, by roadsides and in old fields. It is abundant in moist places by paths in the parks of Greater New York. It must be collected in May to get the calyptra in position. *Pottia truncatula* may be found and confused with the Urn Moss, which it closely resembles. *Pottia*, however, is smaller, being about one-half as large, matures its capsules in winter, and under a lens will be seen to have the midrib excurrent instead of ending in or below the apex of the leaf, as in the Urn Moss.

FUNÀRIA Schreb.

Funaria strongly resembles *Physcomitrium* in everything except sporophyte characters. Calyptra inflated at base, finally oblique with base cucullate. Capsule more or less gibbous, narrowed to a rather short neck, wrinkled to strongly sulcate when dry; mouth more or less one-sided. Peristome double in our species; teeth 16, often twisted spirally and united at their tips; segments 16, opposite the teeth, without basal membrane or intermediate cilia.

KEY

1. Leaves long acuminate, costa excurrent in some of the leaves of each plant 2.
 Leaves short acuminate, costa percurrent, sometimes very shortly excurrent 3.
2. Capsules curved and unsymmetric but scarcely cernuous; annulus lacking *Americana*.
 Capsules plainly cernuous; annulus large *flavicans*.
3. Segments of inner peristome at least $\frac{2}{3}$ length of teeth; spores 12-16 μ in diameter;
 common everywhere *hygrometrica*.
 Inner peristome rudimentary; spores 24-32 μ ; rare *microstoma*.

F. hygrométrica (L.) Sibth. the Cord Moss, is so called because of the twisted seta, which is very hygroscopic and untwists when moist. Its Latin name, *Funaria*, is derived from *funis*, a rope. This twisting of the seta is not peculiar to this moss, however, but is a very common thing in nearly all moss families. The lower leaves are shorter than the upper, which are rather closely imbricated into a bulb-like tuft, oblong-ovate, acute or short acuminate, entire or nearly so; costa ending in the apex; leaf cells inflated, subhexagonal; capsules very unsymmetric, when dry deeply sulcate with mouth apparently on one side (see glossary, Fig. 23.) at first yellowish, turning brown when old; annulus of two or three

rows of cells, falling with the lid; peristome teeth red, hyaline and appendiculate at apex, united by their tips to a small central disk; segments papillose; spores $13-16\mu$, maturing early in June. (For further illustrations, see Plates I, II, III, IV and V, also Fig. 1.)

The Cord Moss is to be found everywhere, being especially abundant in waste places and on soil recently burned over. I have seen it completely cover the soil in an old strawberry bed. When mature it is easily recognized by the peculiar looking curved capsule with its mouth on one side. When immature it is much harder to recognize, because the capsule is erect and nearly symmetric and the calyptra has not assumed the rakish position indicated in the figures.

This moss has, perhaps, been given a more careful study than any other species; it is described in nearly every text-book on botany. It is quite variable in many respects and at least two described varieties are recorded from in or near our range, but authentic specimens or a large acquaintance with the species are necessary to determine these varieties with certainty.

F. micróstoma B. & S. is a rare species of the western portion of our range, closely resembling *hygrometrica*, but is smaller in size, and the capsules have a much smaller and less unsymmetrically placed mouth. The inner peristome is rudimentary and the spores are about twice as large as in *hygrometrica*.

F. flávicans Mx. is found from New York southwards. We are in-

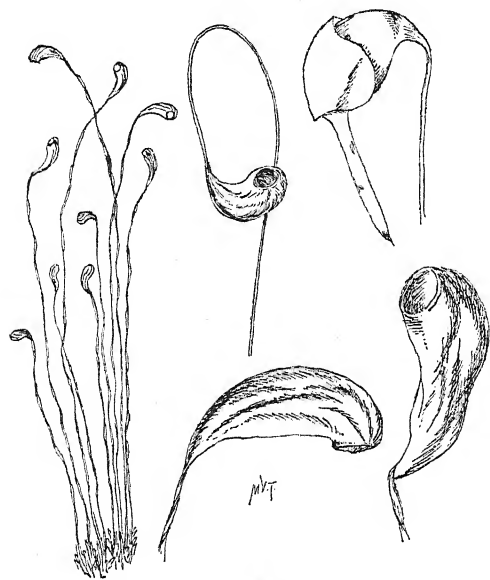


FIGURE 97. *Funaria hygrometrica* $\times 2$, with capsules of various ages and degrees of magnification.

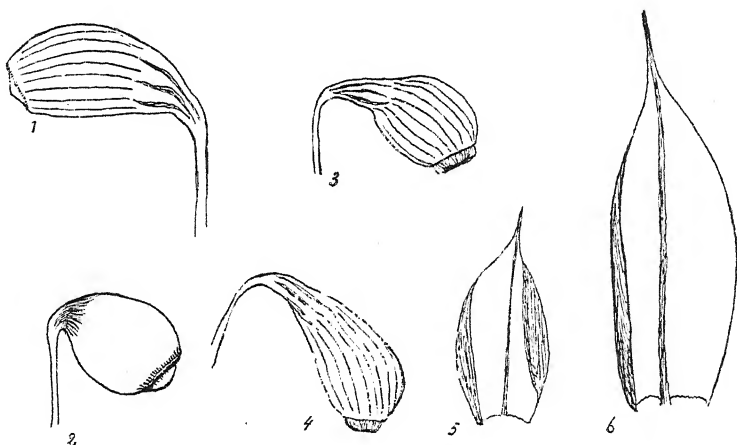


FIGURE 98. *Funaria flavicans* (From the Bryologist, by permission.) 1. Capsule not quite mature. 2. Mature capsule with abnormally short neck. 3 and 4. Ripe capsules without lid. 5 and 6. Middle and upper leaves. Figures magnified about 11 diameters.

debted to Mr. R. S. Williams for the drawings and the following notes, which are taken from the "Bryologist" of January, 1901: "The species grows in separate tufts as well as mingled with *hygrometrica*, from which it may be distinguished by the average smaller size, erect pedicel, more pointed leaves, and

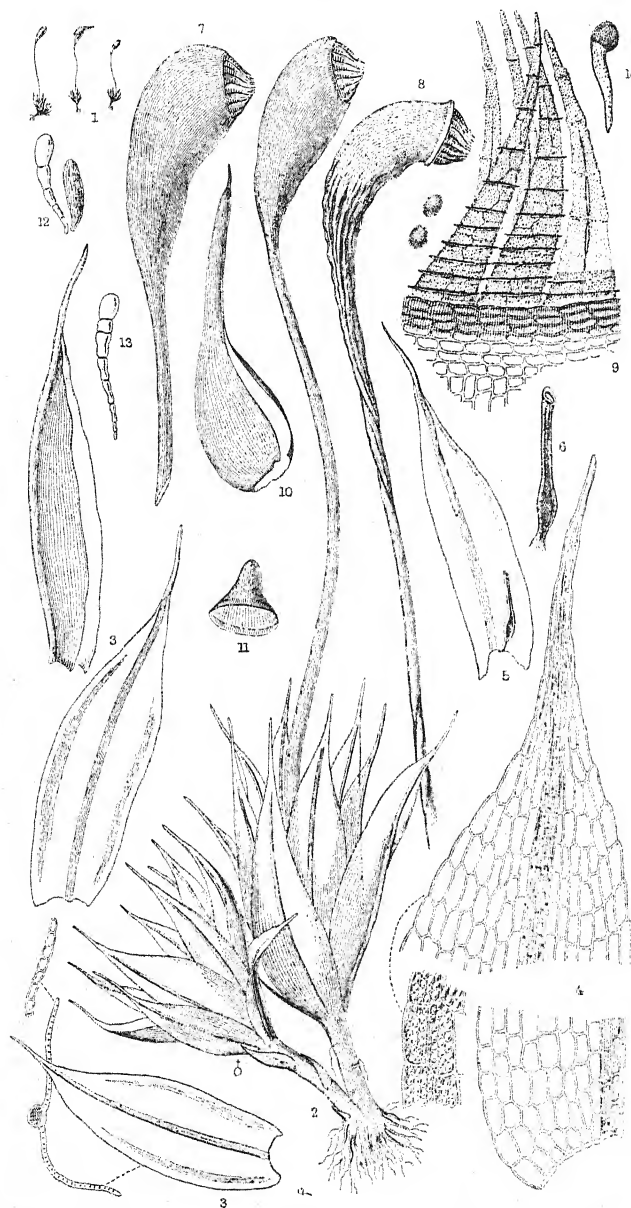


FIGURE 99. *Funaria Americana* (From Sulliv. "Icones," slightly reduced.)

mouth less oblique, as well as much less furrowed capsule, which matures a week or two earlier than in *hygrometrica*, in this region at least. When well ripened, the capsules are very dark reddish, with a low convex lid, not apiculate." Mr. Williams also states that the mouth of the capsule is constantly smaller in *flavicans*. The spores are about 25μ in diameter. The long acuminate leaves with the costa often excurrent, are very distinct from those of *hygrometrica*.

F. Americana Lindb. has been collected in but 5 or 6 localities so far as present records go. But as it has been found in Pennsylvania, Ohio, Georgia and Minnesota, it is widely distributed, and every enthusiastic collector should be on the lookout for it. The small size of the plants, the long acuminate leaves with excurrent costa, the longer necked capsules, without annulus, and nearly smooth above when dry, should render it easy of recognition. The capsules are often contracted below the mouth when dry and empty in a way not shown in the figure. The spores mature in the middle of May.

F. serrata Brid. is a species confined to the southern states and not found in our range. It is easily recognized by its strongly serrate leaves with costa ending below the apex.

Family 16. Meeseaceae

Plants of wet boggy places, frequently growing with Sphagnums. Leaves spreading to squarrose-recurved, of a rather firm structure, ovate-lanceolate to elongated-lanceolate. Costa long and stout, ending a little below the apex. Leaf cells smooth (papillose in *Paludella*), rather small above, large and more elongated below. Seta usually *very long and slender*. Calyptra cucullate. Capsules curved-pyriform, with a conspicuous neck, smooth or somewhat striate when dry; operculum small, short conical; mouth small; annulus of one or two rows of cells; peristome double, the inner usually much longer than the outer and consisting of 16 narrow segments alternating with the teeth, cilia sometimes present.

All our mosses of this family seem to be rather rare. The bog habitat, the long seta and the curved pear-shaped capsules with a small mouth, clearly establish the identity of any member.

MEESEA Hedw.

Stems more or less elongated and radiculose. Upper leaf cells rectangular to hexagono-rectangular. Neck of capsules long; segments of inner peristome often united by lateral hairlike appendages bearing nodules; teeth short, usually obtuse. The spores of our species ripen from late June to August.

KEY

- | | |
|--|-------------------|
| 1. Leaf margins revolute, apex rounded | <i>trichodes.</i> |
| Leaf margins plane, apex acute | 2. |
| 2. Leaves entire | <i>longiseta.</i> |
| Leaves serrate | <i>triquetra.</i> |

M. triquetra (L.) Aongstr. (*M. tristicha* B. & S.) is apparently our most frequent species. Limpricht says that the leaves are serrate in the varieties only, but I find them serrate in all the American specimens examined, just as they are represented in Plate XLII by Schimper. They are strongly squarrose from a strongly decurrent and half-clasping base, as is well shown in the plate.

M. longiseta Hedw. has entire leaves, spreading from an erect base without the abrupt bend of those of the preceding species.

M. trichodes (L.) Spruce (*M. uliginosa* Hedw.) is easily distinguished by its long, narrow leaves with entire and loosely revolute margins, and stout costa ending a little below the very blunt rounded apex.

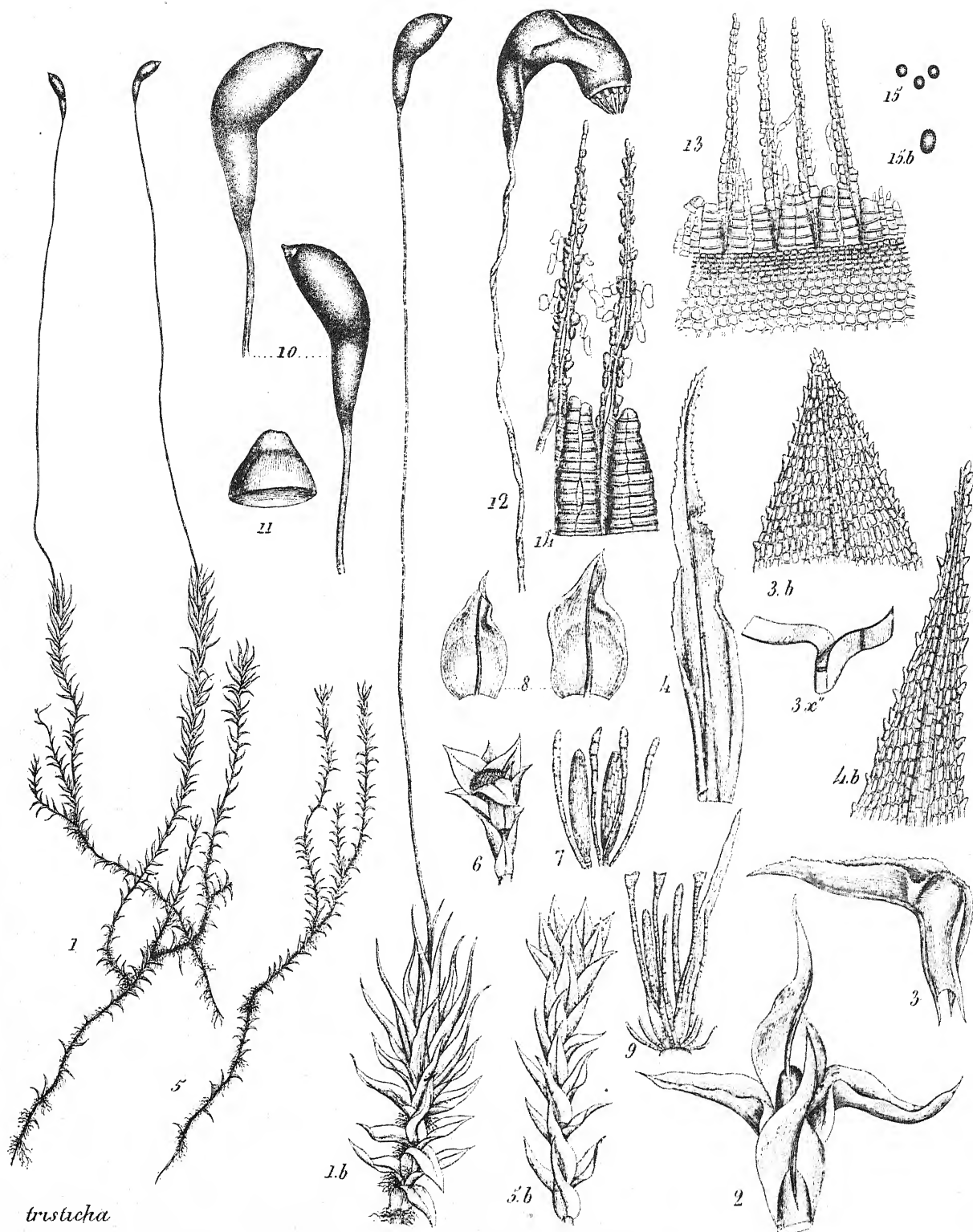


PLATE XLII. *Meesia triquetra* (From Bry. Eur.)

Paludella squarrosa (L.) Brid. is a rare member of the family with stems densely radiculose, the leaves broadly ovate-lanceolate, densely and finely serrate and *strongly recurved squarrose*. The leaf cells have low broad papillæ on both sides. The capsules are less inclined than in *Meesea* and have a much shorter neck. The outer peristome is fully developed and as long as the inner. The leaves are so strongly recurved as to often appear doubled up when mounted and it is impossible to flatten one out.

Family 17. Timmiaceae

Tall robust mosses resembling *Polytrichum* in appearance when sterile; growing in deep loose tufts on soil and rocks. Leaves lanceolate from an appressed sheathing base, serrate above, strongly costate to apex, but costa much narrower than in *Polytrichum*, and entirely without lamellæ; leaf cells small, round-hexagonal, smooth or rarely lightly papillose. Calyptra cucullate; seta long; capsules often somewhat wrinkled when dry, but scarcely plicate or sulcate, when fresh resembling those of *Mnium* and *Bryum*. Peristome like that of *Mnium*, except that the inner is composed of cilia only, which are grouped together in fours.

TIMMIA Hedw. (Our only genus.)

T. megapolitana Hedw., as figured in Plate XLIII, is probably found only in the Rocky Mountains and northwards. It is a European species also. Note that in the figure the capsules are nearly or quite symmetric and that the mouth of the capsule is not wider than the lower portions. These figures represent the European form very well, though there are occasionally capsules that are plainly unsymmetric.

The form of the species found in our region has been called *T. cucullata* Mx. It is very much like the European form in gametophyte characters, but the capsules are strongly curved and unsymmetric when dry and empty and the mouth is the widest portion, the capsules tapering gradually from the mouth to the seta. The capsules resemble those figured for *Hypnum curvifolium*, only they taper more rapidly. The spores mature in May. On damp shaded banks, sometimes at base of trees. Frequent. Williams (Bryologist 4:27) says that the median leaf cells of *T. cucullata* are 12μ in diameter and those of *T. megapolitana* 8μ . Limpricht and Roth, it is well to remember, give the cells of *T. megapolitana* as 12μ or more in diameter.

I suspect that *Timmia* is much more common than is generally recognized and that when sterile it is passed over for a *Polytrichum* (See Bryologist, 8:52)

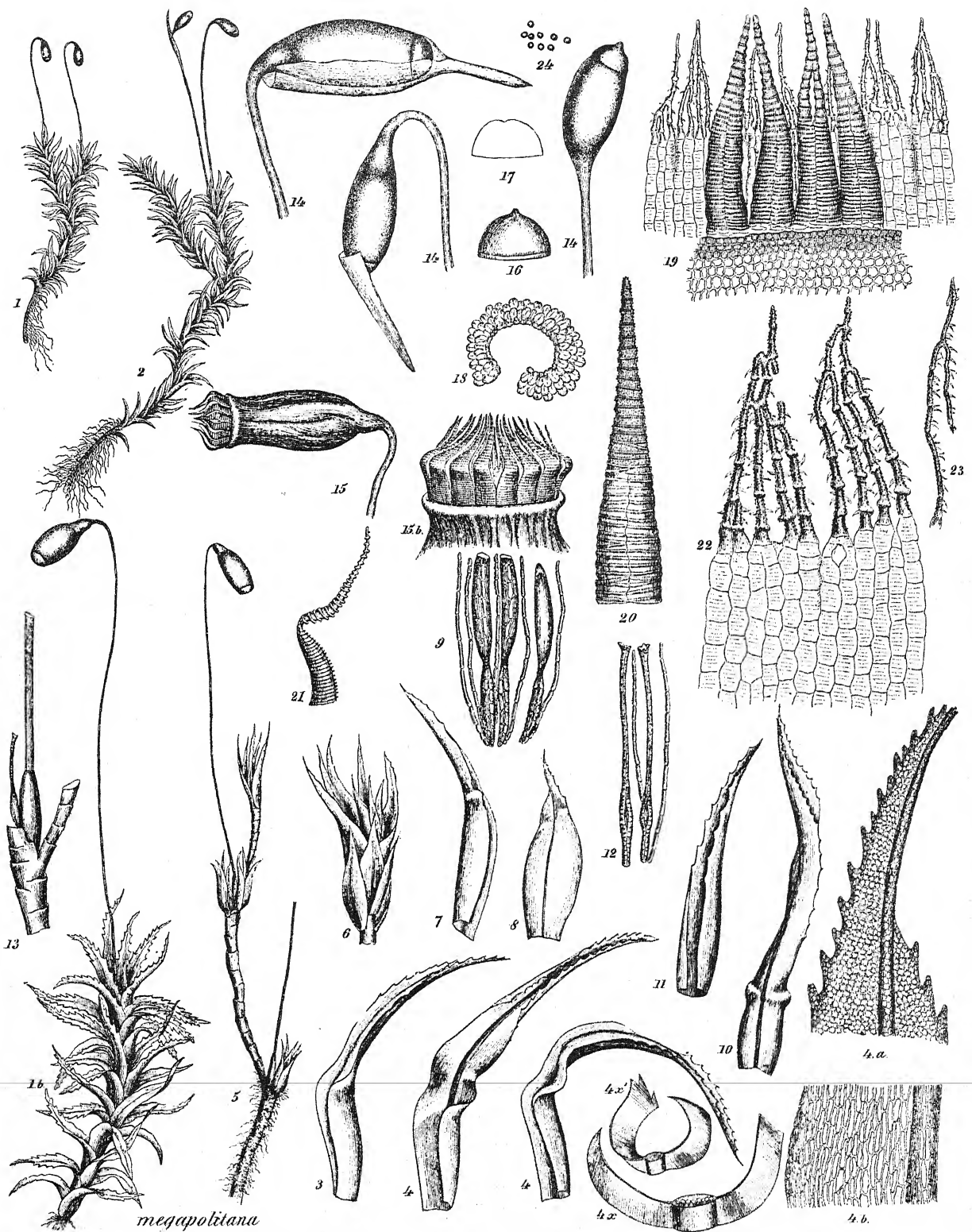


PLATE XLIII *Timmia megapolitana* (From Bry. Eur.)

Family 18. Aulacomniaceae

Intermediate between the *Bartramiaceae* and the *Mniæ*, with some characters of the *Meeseaceae*. From the *Mniæ* it differs in the much smaller papillose leaf cells and in having the capsule regularly striate or sulcate when dry. From the *Bartramiaceae* it differs in the larger broader leaves and the more elongated and less unsymmetrical capsules with well-developed cilia in the inner peristome. It differs from the *Meeseaceae*, except *Paludella*, in the perfectly developed peristome, less conspicuous neck of the capsule, and the papillose leaf cells.

AULACOMNIUM Schwaegr.

Usually caespitose, growing on soil in moist woods or in bogs; green above, often brown or brownish green below; stems often densely matted with radicles. Leaves large strongly costate, nearly or quite to the apex; leaf cells small, rounded, strongly thickened at the angles (collenchymatous), in most species strongly papillose on both sides, each cell bearing a single large papilla

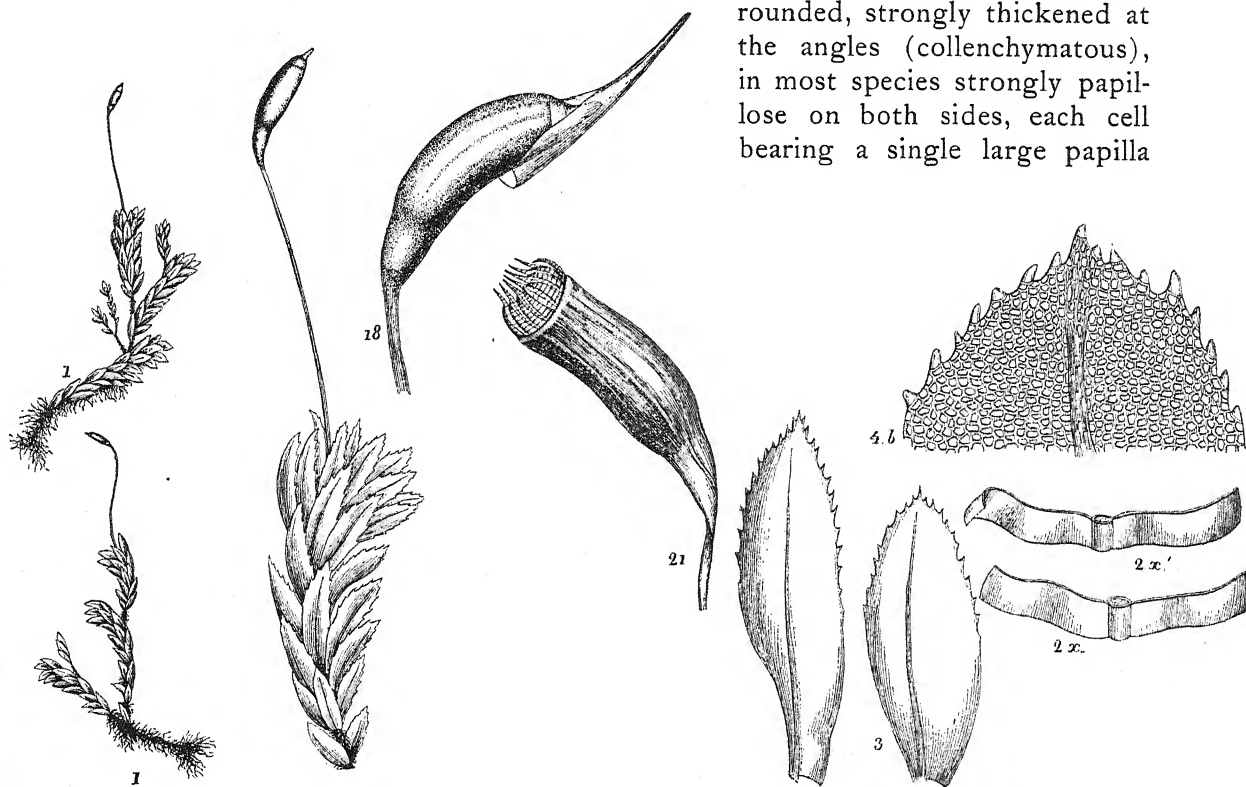


FIGURE 100. *Aulacomnium heterostichum* (From Bry. Eur.). 1. Plants natural size. The other figures are self-explanatory.

in the middle of each surface. Branches frequently terminating in flagelliform pseudopodia bearing propagula at their tips; calyptra cucullate; capsule oblong to subcylindric, cernuous and usually somewhat unsymmetric, with a short neck (so short as to be easily overlooked in some species), regularly plicate or sulcate when dry. Annulus early deciduous. Peristome perfect, as in *Mnium*.

KEY

1. Leaves broad, obtuse, entire; dioicous *turgidum*.
 Leaves broad, apex rounded or acutish, strongly serrate; monoicous *heterostichum*.
 Leaves lanceolate, acute, serrate or crenulate at apex; dioicous 2.
2. Basal cells in one layer, scarcely different from the rest; brood bodies like minute ecostate leaves *palustre*.
 Basal cells swollen, in two or three layers; brood bodies stalked, fusiform *androgynum*.

A. heterostichum (Hedw.) B. & S. looks so much like a *Mnium* that it might well be called the Ribbed *Mnium*. It is common on rich moist soil (not wet) in woods, especially about the bases of trees. The ribbed or wrinkled capsules and broad *Mnium*-like leaves, coarsely serrate and without border, are its distinguishing marks. The spores mature in early spring, but the young "lances" are well started in the preceding autumn. When thoroughly dry the capsules are more strongly wrinkled, and more contracted under the mouth than is shown in the figure.

A. túrgidum (Wahlenb.) Schwaegr. is a very rare moss of mountain bogs. The stems are not radiculose, except at the very base; the leaves are ovate to oblong-obovate, strongly concave, obtuse, rounded and entire at the apex; margins strongly revolute in the lower part; cells weakly papillose, basal cells in two or three layers; pseudopodia lacking. Capsules much as in the next; spores in summer. Reported from the White Mountains, Adirondacks, Mt. Katahdin and Lake Superior.

A. palustre Schwaegr., the Ribbed Bog Moss, is very abundant in swamps and wet shaded hollows. It is rather lighter in color than most of the accompanying mosses. It varies exceedingly in size (2-13^{cm} in height) and in robustness,

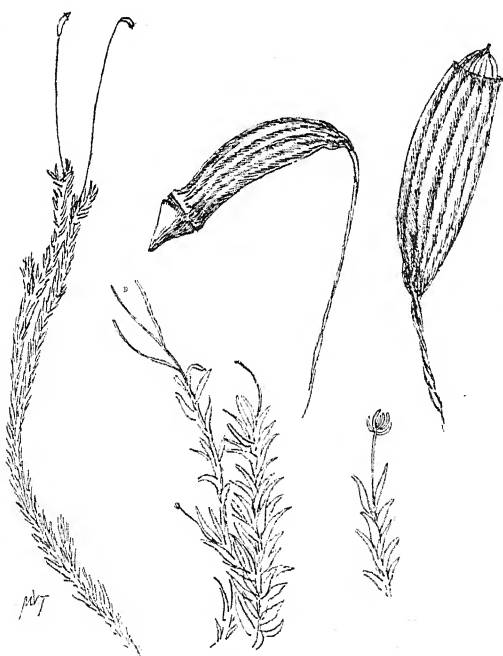


FIGURE 101. *Aulacomnium palustre* \times xi;
 capsules \times 10; pseudopodia \times 4.

some forms being slender and attenuate and others almost as robust as in *A. turgidum*. Stems densely radiculose below; leaves long-lanceolate, acute and finely denticulate or sinuate-crenulate above, strongly revolute below; basal cells somewhat swollen and in two or three layers; pseudopodia frequent, propagula like minute ecostate leaves, very distinct from those of the next species. Capsules plainly curved, unsymmetric and plicate when dry; basal membrane of the inner peristome more than one-half the height of the teeth.

From the figures the capsules might possibly be mistaken for *Ceratodon*, but they are much lighter colored and much longer, and the plants are 3-10 times as large. The plants appear to fruit sparingly, as is often the case with mosses having a special means of asexual reproduction. In the cranberry bogs of Cape Cod capsules are produced very abundantly, at least in favorable seasons.

Var. *imbricatum* B. & S. is a very robust form approaching *A. turgidum* in appearance, but having acute leaves that are strongly papillose as in the species; they are also very large and broad, 3-6 x 1 mm, and nearly or quite entire. Limpricht states that this variety lacks pseudopodia.

A. andrógynum (L.) Schwaegr. is common on the western slope of the continent, but is rather rare within our range. It is most like the last, from which it is distinguished by its smaller size, more strongly serrate leaves, with the cells at base in a single layer, scarcely different or a trifle elongated, and the capsules inclined but nearly symmetric. The brood bodies are quite different also. (See Figs. 22-25 of Plate II and Fig. 22 of the Glossary.)

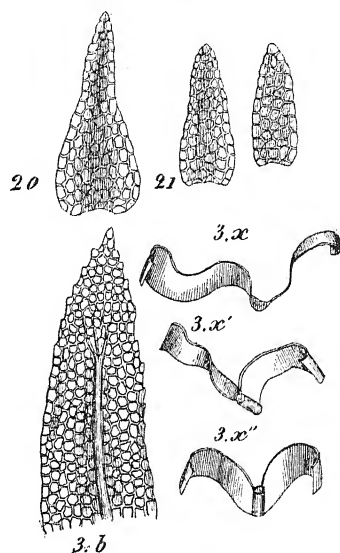


FIGURE 102.
Aulacomnium palustre (From
Bry. Eur.) 20, 21. Propagula.
3b. Apex of leaf. 3x, etc. Different
leaf sections.

Family 19. Bartramiaceae

Plants of medium or large size, usually growing in large deep tufts or cushions on soil or rocks in moist shaded places; often developing whorled innovations below the places where archegonia or antheridia have been produced. Leaves strongly costate to near the apex or beyond, acute, papillose (except *Bartramia Cederi*), usually serrate. Leaf cells roundish-quadrato to rectangular. Calyptra small, cucullate; seta rather shorter than in the related families; capsule nearly globular, usually without neck, usually cernuous and somewhat unsymmetric, regularly plicate or sulcate when dry; peristome

double in all our species, except the rare and alpine *Conostomum*; cilia frequently rudimentary or lacking; segments split along the median line and the halves widely divergent, sometimes appearing as if bordering the teeth.

KEY TO THE GENERA

1. High alpine; peristome single *Conostomum*.
Mostly plants of low or median altitudes; peristome double 2.
2. Leaves elongated-lanceolate to linear-lanceolate; inner peristome with cilia rudimentary or lacking *Bartramia*.
Leaves much shorter, ovate-lanceolate; cilia present *Philonotis*.

PHILONOTIS Brid.

Our species of this genus are water-loving mosses, growing on wet banks and rocks where water trickles, or on the margins of pools or streams. The stems are densely radiculose below. This genus differs from *Bartramia* chiefly in the characters mentioned in the key and in the much more slender habit, with a strong tendency to the whorled innovations mentioned above. The plants are nearly always dioicous and the perigonal leaves are made the basis of specific distinctions in this genus to a very unusual extent.



FIGURE 103. *Philonotis fontana* $\times 1$;
leaf, capsule, and male head $\times 10$.

P. fontána (L.) Brid. Variable in height (3–15 cm) and robustness; stems slender, red, sometimes partially reclining at base; by reason of this and the abundant branching sometimes taken for a pleurocarpous moss. Leaves ovate-lanceolate, long acuminate, appressed when dry, and usually with one or two plicæ on each side of the costa near the base; margins serrate above, usually revolute below; leaf cells rectangular to hexagono-rectangular, with papillæ on the end walls; costa percurrent or excurrent. Leaves of antheridial stems much shorter acuminate, as shown on the stem in Fig. 103. Many of the leaves are much longer and more slenderly acuminate than the separate stem

leaf figured. The perigonal leaves are spreading, broadly triangular-ovate, the inner often obtuse and rounded at apex, serrate, with costa ending below apex. Capsules maturing in May or June; cilia of inner peristome nearly as long as segments. Common everywhere, but fruiting rather sparingly. The whorled branching and characteristic perigonal leaves render the determination of sterile specimens possible without much extra effort.

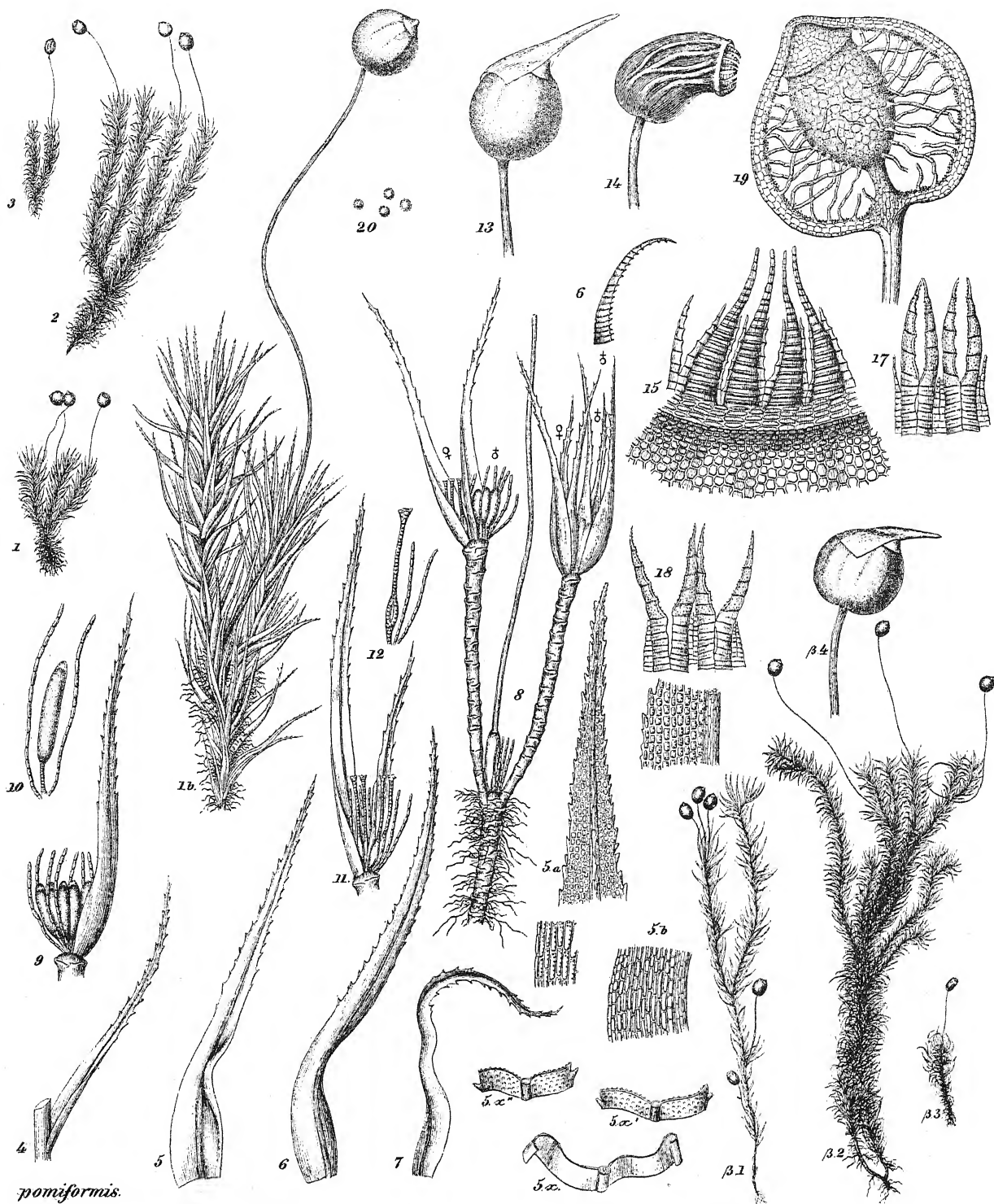


PLATE XLIV. *Bartramia pomiformis* (From Bry. Eur.)

P. Muhlenbergii (Schwaegr.) Brid. This species is frequent throughout the greater part of our range. It seems to be distinguished from *P. fontana* chiefly by the rudimentary cilia of the inner peristome and by the erect lanceolate acute perigonal leaves with the costa percurrent in inner leaves. The inner perichæatial leaves are said to be shorter than the outer, and Sullivant says the leaves lack the plicæ of *P. fontana*.

BARTRÂMIA Hedw.

The Bartramias grow in moist niches in cliffs and on moist shady banks, looking much like tufts of green wool. Their capsules are globular and somewhat unsymmetric when moist, but dry with regular folds and alternate ridges. When very dry the body of the capsule becomes so shrunken as to be smaller than the mouth of the capsule itself. The leaves are long and slender and somewhat curled when dry, and strongly papillose. *B. Cæderi* is somewhat of an exception as regards leaf characters, and by recent writers is put in the genus *Plagiopus*.

KEY

1. Leaves lanceolate, not papillose *Cæderi*.
 Leaves nearly linear, very long and narrow, papillose 2.
2. Leaves from a sheathing scarious base *ithyphylla*.
 Leaves without sheathing base *pomiformis*.

B. pomiformis (L.) Hedw. is often known as the Apple Moss. It is a common and beautiful plant, 2–7^{cm} in height. The leaves are long linear-lanceolate, 4.5^{mm} long, somewhat crisped when dry, papillose and serrate, with margins recurved; costa excurrent; autoicous or synoicous; spores in April or early May.

B. Cæderi (Gunn.) Swtz. is a smaller, less common plant of cool, moist ravines. The leaves are much shorter, lanceolate, not crisped when dry, not papillose, margins sharply serrate and widely revolute most of the way; spores two or three weeks later than in *B. pomiformis*. The leaves of this species and also of *B. pomiformis* are serrate on the roll, or apparent edge, of the revolute margin. These teeth might possibly be mistaken for papillæ.

B. ithyphylla (Haller) Brid. is a rare alpine species resembling *B. pomiformis*, but

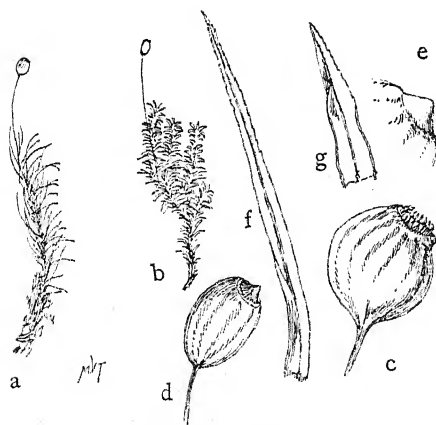


FIGURE 104. a. *Bartramia pomiformis* × 1. b. *B. Oederi* × 1. c. Capsule of *B. pomiformis* × 10, and e, mouth of same with operculum. d. Capsule of *B. Oederi* × 10. f and g. Leaves of *B. pomiformis* and *B. Oederi* respectively × 10.

known at once by its very narrow leaves from a wide sheathing scarious base. The costa, though excurrent, is hard to distinguish from the lamina.

Conóstum boreale Swtz. is a high alpine plant reported from the Adirondacks and the White Mountains, and from Gaspé, Quebec. It is readily collected near the summit of Mt. Washington. The capsules will at once mark it as a member of this family. The bright glaucous-green color and five-angled leafy stems will easily distinguish it from our other species of the family.

Family 20. Bryaceae

For the most part large conspicuous mosses growing in close tufts, or loosely aggregated, or scattered; some forms spreading by stolons have the habit of sterile pleurocarpous mosses. Leaves usually large, smaller below and increasing in size upward to the upper, which often form a distinct comal tuft, all supported by a strong costa which extends nearly to the apex, or may be somewhat excurrent, and in many species by a thickened border of narrower elongated cells. Leaf cells large and comparatively thin-walled, short and broad in the *Mniæ*, longer and narrower in the *Bryæ*. A few species are small with small leaves, but with the characteristic sporophyte of the family. Calyptra cucullate. Capsules proportionately large, pendent or drooping, often light-colored, not striate or plicate when dry, usually symmetric. Peristome characteristically perfect, of the type described on pages 34 and 35 for *Mnium hornum*, cilia sometimes rudimentary or lacking.

KEY TO SUBFAMILIES

- Plants larger; leaf cells not more than twice as long as broad; cilia not appendiculate (*Rhodobryum* will be sought here) *Mniæ*.
Plants usually smaller; leaf-cells more than twice as long as broad; cilia often appendiculate, occasionally wanting *Bryæ*.

SUBFAMILY 1. BRYEÆ

1. Plants large, with the habit of a large *Mnium*, from creeping, rhizomelike stolons; upper leaves in rosettes 12-20^{mm} across; capsules clustered *Rhodobryum*.
Plants smaller, without rhizomelike stolons 2.
2. Leaves ovate to ovate-lanceolate; leaf cells rhombic to rhombic-hexagonal, never linear except at margins 4.
Leaves linear-lanceolate or narrower (the lower are often broader); leaf cells narrowly rhombic to linear 3.
3. Leaves linear from a broader base, hairlike; cilia appendiculate *Leptobryum*.
Upper leaves linear-lanceolate; cilia not appendiculate, sometimes wanting . . . *Pohlia*.
4. Leaves not bordered; dioicous; annulus lacking; stomata immersed; leaf cells long and lax; growing in water or very wet places *Mniobryum*.
Leaves often bordered; inflorescence various; stomata superficial; leaf cells usually shorter *Bryum*.

With the exception of *Rhodobryum*, *Leptobryum*, *Plagiobryum*, *Bryum argenteum* and possibly *Mniobryum*, it is extremely difficult to determine species of this subfamily unless perfect fruiting specimens can be obtained. It will be a discouraging task to any one except a specialist in the group, and one not worth while under any ordinary circumstances.

LEPTOBRYUM Schimp.

L. pyriforme (L.) Wils., the Long-necked Bryum. Plants annual; not branching above; leaves hairlike, from a broader base; costa broad, excurrent; leaf cells narrow, linear. Capsules inclined or pendulous, pear-shaped, with a long narrow neck; cilia of inner peristome strongly appendiculate; spores in June and July.



FIGURE 105. *Leptobryum pyriforme* × 2; leaf and capsule × 10.

This common and pretty species is easily recognized by its long-necked capsule and slender hairlike leaves. Some species of *Pohlia* have very long-necked capsules, but the leaves are so much wider that there is no need of confusing them with this. This species is frequent on moist shaded cliffs and on rocks near water. It is more common than the author once thought, for it is frequent on damp mortared walls in

various situations. The author has collected it on the basement of his Brooklyn house and in the cut which leads up to Montague Street from the Brooklyn end of the Wall Street Ferry.

PÖHLIA Hedw.

Plants tufted, usually growing on moist or wet soil and stones. Lower leaves shorter, ovate-lanceolate as a rule, the upper longer, the comal usually linear-lanceolate; costa ending just below apex, percurrent or rarely excurrent; leaf-cells narrowly rhomboidal to linear; capsule pear-shaped or clavate, usually with a proportionately long tapering neck; cilia of inner peristome not appendiculate.

This genus is sometimes treated as a subgenus of *Bryum*, from which it differs in little except the narrower areolation and narrower comal leaves.

KEY

1. Capsule long and narrow, with a very long neck (see Fig. 106) *elongata*.
 Capsule oblong or pear-shaped, neck shorter 2.
2. Capsules very short and small (see Plate XLV); stems not red *Lescuriana*.

- Capsules larger and longer; stems often red when old 3.
3. Bearing gemmæ in the axils of the leaves of the sterile stems; dioicous; infrequent or rare 5.
- Not producing gemmæ; never wholly dioicous, sometimes polygamous 4.
4. Infrequent, growing principally in the mountains; leaf cells very long and narrow, linear-vermicular, 11-16:1; lower leaves large, broadly ovate *cruda*.
- Common everywhere; leaf cells broader; lower leaves smaller than in *cruda*, ovate *nutans*.
5. Gemmæ as in Fig. 108 *annotina*.
- Gemmæ as in Fig. 109 *proligera*.

P. elongata Hedw. is a rather rare moss found only in the mountains. It grows on damp soil in cool shaded places, especially in crevices of rocks near streams. It is at once known by the slender long-necked capsule, which is never to be confused with the Long-necked *Bryum*, because of the different position of its capsules and its broader, lanceolate leaves. The spores mature in August.

P. acuminata Hornsch is a very rare species reported only four or five times from our range. It is very like the last, but differs in having the neck shorter than the rest of the capsule, cilia of inner peristome rudimentary or wanting, and inflorescence autoicous; while in *P. elongata* the neck is longer than the rest of the capsule; the cilia fairly well developed, and inflorescence paroicous.

P. nutans (Schreb.) Lindb. is one of the mosses most frequently sent me for determination. It grows everywhere in moist or swampy places on peaty soil, rotten wood, etc. The plants vary from 1-5^{cm} in height, rarely over 2^{cm} as I find them. The upper leaves are long and narrowly lanceolate, faintly serrate at apex, and not margined. The costa is strong and ends below the apex as a rule, though occasionally it may be percurrent or rarely even excurrent in the upper perichætil leaves. The lower leaves are shorter and broader than those figured. The antheridia are in the axils of the upper leaves and are very easy to find even after the capsule has disappeared. The capsules are usually contracted below the rather broad mouth when dry. The annulus is broad, the cilia of the inner peristome two, well developed; segments widely open along the middle line, but not split at apex; spores in spring or summer. The plants are variable in appearance and in some of

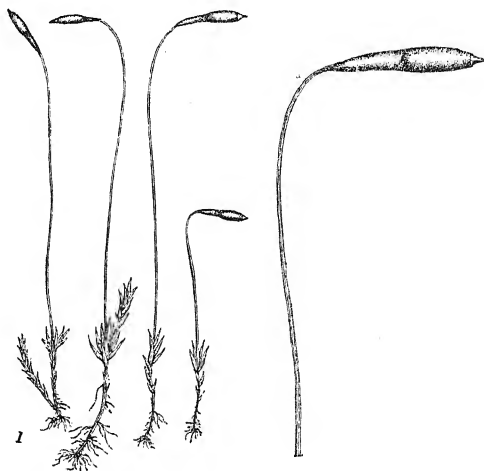


FIGURE 106. *Pohlia elongata* natural size and capsule enlarged. (From Bry. Eur.)

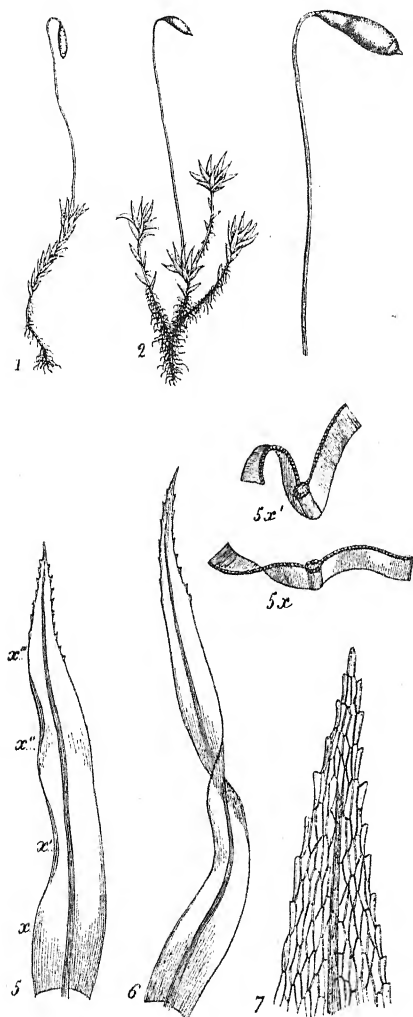


FIGURE 107. *Pohlia nutans* (From Bry. Eur.). 1 and 2. Plants natural size. 5, 6 and 7. Comal leaves.

their characters also, but the species is so common that one soon becomes familiar with it. The stems and base of costa are often red. Several varieties have been described.

P. cucullata (Schwaegr.) Bruch is hardly more than a subspecies of the last. It is very rare, being reported from the White Mountains only, within our range. It differs from *nutans* in having some of the rather shorter leaves subentire and rather obtuse, sometimes almost cucullate; cilia of the inner peristome short and easily broken off; capsules narrowed at mouth, but not contracted below it. The capsules are also said to be bent more closely to the seta.

P. cruda (L.) Lindb. is an infrequent alpine or subalpine species growing in the crevices of rocks in cool or elevated situations (N. J., Austin; Lake George, Jelliffe). It is larger than any of the preceding species, 2–8 cm, with simple red densely tufted stems. The lower leaves are broadly ovate, often deep red at base in lamina as well as costa; the upper long linear-lanceolate; median leaf cells linear-vermicular, longer and narrower than in any of our other species, 11–16:1, costa ending below apex. Autoicous, sometimes synoicous or dioicous. Capsules with an inconspicuous neck, less drooping than in the allied species, sometimes merely inclined; peristome pale yellow, with well-developed cilia; spores in

summer. Until one has seen both species, this might be confused with *P. nutans*, but one who has seen both could hardly make this mistake, as the italicized characters are so clear and conspicuous. Dixon says "a very fine and beautiful species known at once by the metallic, almost opalescent sheen on the leaves, which are larger and wider than in the allied species."

P. Lescuriàna (Sulliv.). Plants small, 1–2 cm, loosely aggregated, stems never red; lower leaves distant, narrowly lanceolate; the upper linear-lanceolate, very long and narrow; all serrulate above, more or less recurved on the middle margins; leaf cells more elongated than in *nutans*. Dioicous; male plant

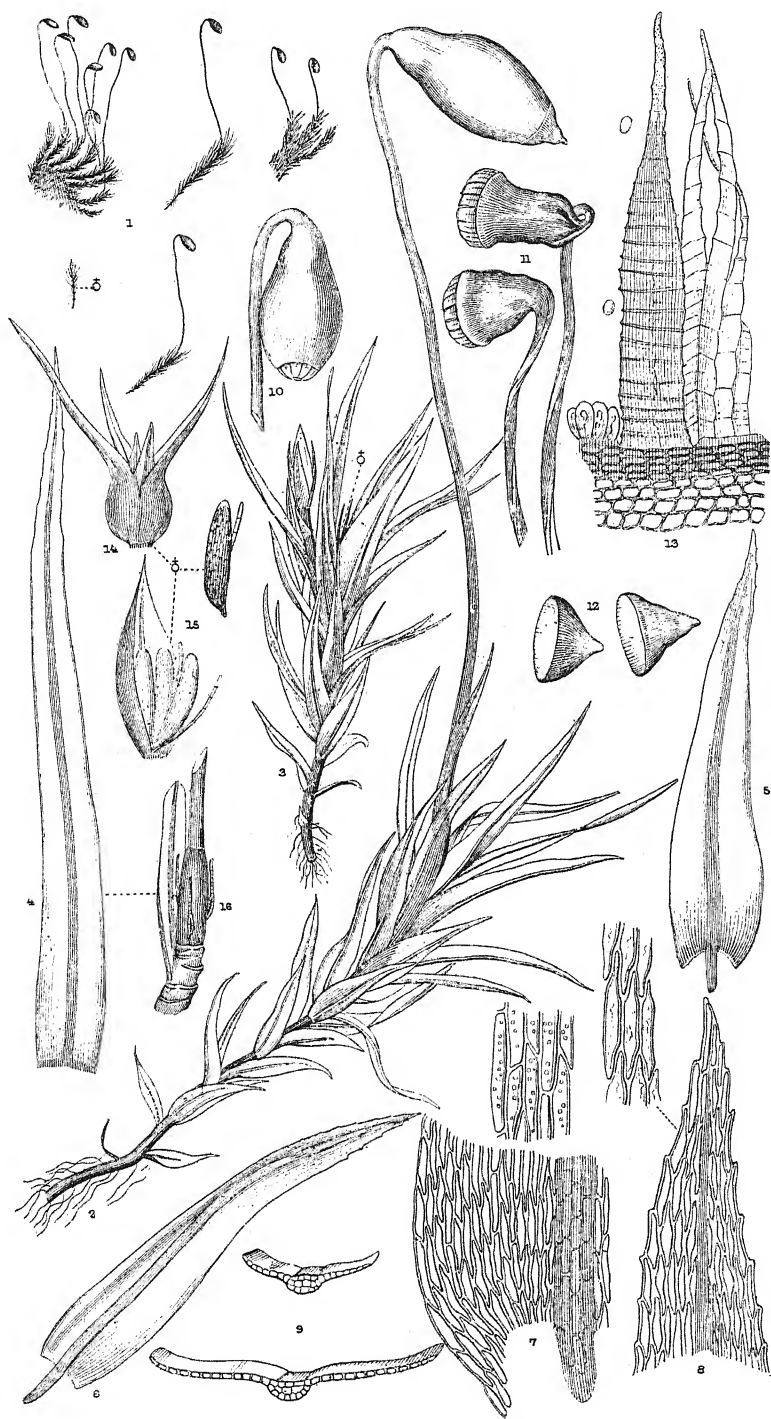


PLATE XLV. *Pohlia Lescuriana* (From Sulliv. "Icones")

smaller. Capsules very small, maturing in May. On moist soil, infrequent. According to Harald Lindberg this is the same as *P. pulchella* (Hedw.) Lindb.

P. annôtina (Hedw.) Lindb. is another rather rare species of a moist mountainous habitat. The plants are small, 2^{cm} or less in height, with the old stems often sending up straight, rather stiff and slender innovations. The sterile stems usually bear small green ovoid gemmæ in the axils of the upper leaves. (See Fig. 108 and also Plate II, Figs. 20 and 21.) The leaves are broadly lanceolate below, longer and narrower above, serrulate toward the apex; costa nearly or quite percurrent, often red at base. Dioicous; peristome with well developed cilia; capsules rather small, sometimes almost as small as in the preceding, maturing in summer. Rare.

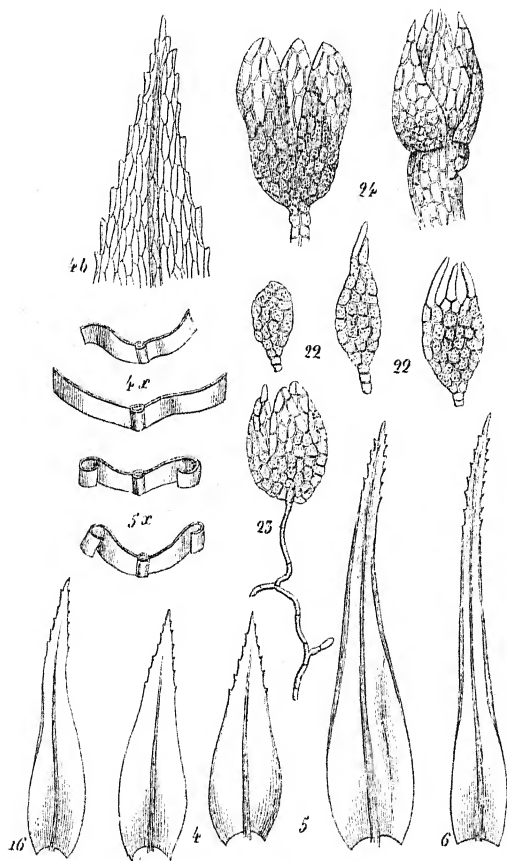


FIGURE 108.

Pohlia annotina (From Bry. Eur.) 4 and 5. Lower leaves. 6. Upper leaves. 22-24. Gemmæ.

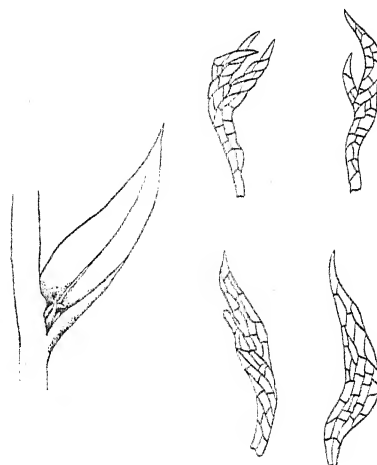
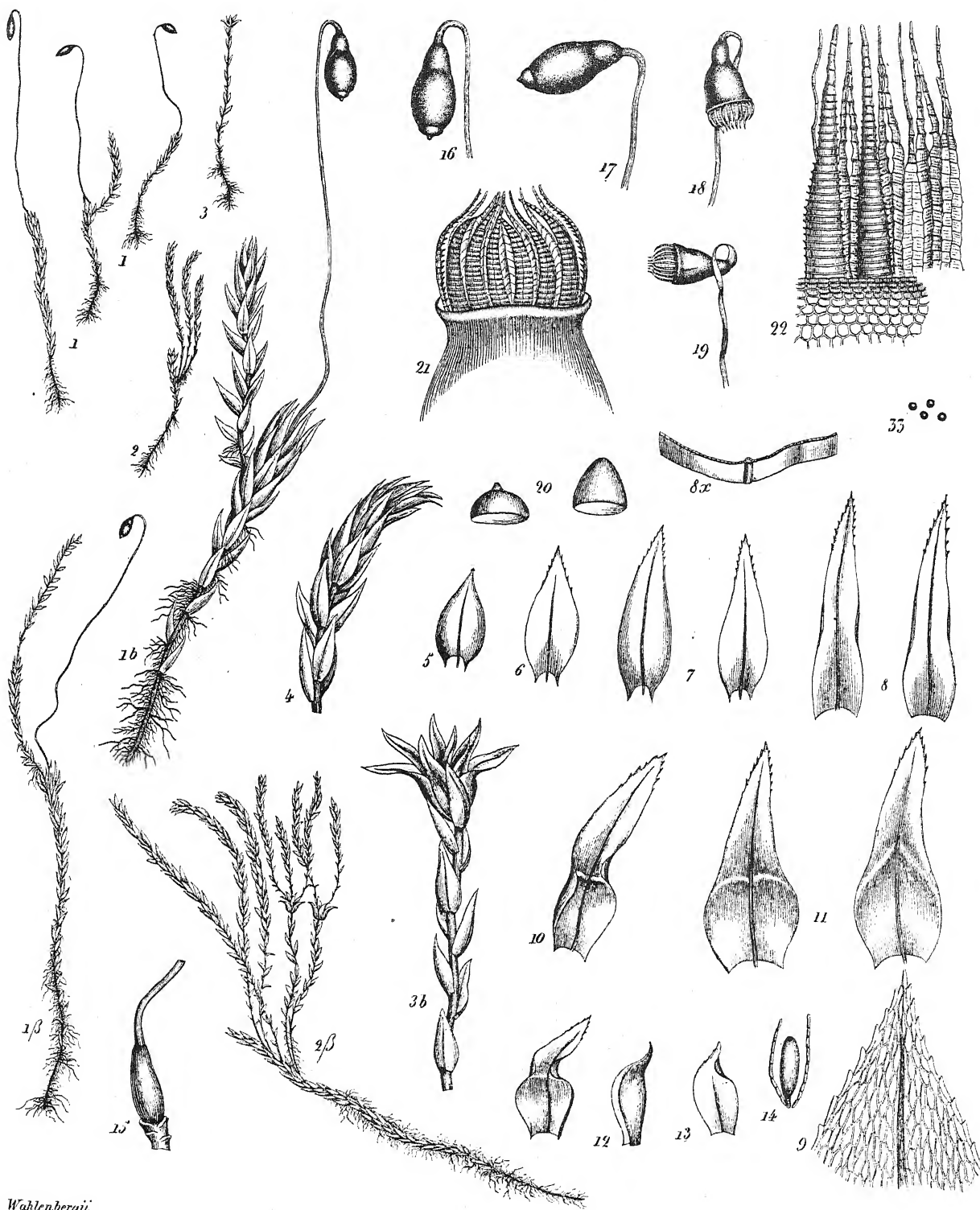


FIGURE 109.

Gemmæ in axil of leaf of *P. proligeræ* $\times 25$, and several gemmæ $\times 150$.

P. proligeræ (Lindb.) Correns has until recently been confused with the last, and even now is by some authors regarded as a subspecies of it. It is widely distributed in our range. It is distinguished by the long narrow gemmæ essentially like those figured, although the form varies considerably. The points of the gemmæ are longer than in *annotina* and usually somewhat twisted; the gemmæ are produced from April to November. For a fuller account of this species see the Bryologist 4: 62.



Wahlenbergii

PLATE XLVI. *Mniobryum albicans* (From Bry. Eur.)

MNIOBRYUM (Schimper ex parte) Limpr.

All species dioicous; antheridia in the axils of the perigonial leaves. Leaves serrate at apex, not margined, but marginal cells somewhat narrower than the median; leaf cells as a whole broader than in *Bryum* but longer and narrower than in *Mnium*, thin-walled. Capsules pendent, small and short, pear-shaped; *stomata immersed*; annulus lacking; peristome perfect. Plants of wet places, such as springs, ditches, banks of streams and ponds.

M. álicans (Wahlenb.) Limpr. (*Bryum Wahlenbergii* Schwaegr.). Growing in large soft lax tufts, whitish or glaucous green, 2–8^{cm} high; stems bright red in the older portions. Antheridial plants often branching by innovations. Leaves distant, much shrunk when dry, ovate-lanceolate, often narrowly so, obtusely acute; margins plane, serrate above; leaves of antheridial plants often somewhat narrower; leaf cells rhombic-hexagonal, pellucid, thin-walled, averaging about 20^μ in width, narrower at margins; costa red at base except when very young, not quite percurrent; capsules wide-mouthed when dry and empty, maturing in spring or early summer. Common but fruiting infrequently.

M. cárneum (L.) Limpr. is much smaller, 1–2^{cm} in height, with narrower lanceolate leaves having two or three rows of distinctly narrower marginal cells, which are much more conspicuous than in *álicans*. This species is found in the far west and has been reported from Minnesota and the Central States, and may be found farther east.

BRYUM Dill.

Plants densely tufted, interwoven with radicles, usually with branches arising below the "flowers." Leaves ovate to lanceolate, thin and very little hygroscopic, rarely obtuse; cells smooth, rather large, rhombic to hexagonal, quadrate to rectangular at base, the marginal often very narrow and forming a more or less distinct, sometimes thickened border; costa usually excurrent. Capsule on a long seta, usually more or less pendulous, pyriform but varying from subglobose to elongated-clavate, usually symmetrical; operculum conical, usually apiculate but never rostrate; annulus present; peristome of 16 long-lanceolate, closely articulate teeth; the inner of a basal membrane about half the length of the teeth, bearing 16 lanceolate keeled segments alternating with the teeth, and often split along the keel, usually with 1–3 cilia between the segments. When fully developed these cilia are appendiculate, *i. e.*, bear short transverse appendages at the articulations; the cilia are sometimes rudimentary and in a few species the inner peristome is adherent to the outer. Growing on the ground, rocks and walls, rarely on wood of any sort.

This is a very large and difficult genus, and there seems to have been more

hair-splitting in it than in almost any other in the vegetable kingdom, except in the Thorn Apples (*Crataegus*). Indeed, it sometimes seems as if the classification had become so involved that the prominent authorities find it easier to make new species for their specimens than to refer them to their proper place in the species already described. A very large proportion of the species seem to be distinguished by little or nothing except the arrangement of the sexual organs. Until the constancy of these characters has been tested by cultures, one can not help the feeling that this is a very insufficient basis for specific distinction, in many cases at least. The other specific characters, such as border of leaf or length of costa, are often quite variable even on the same plant, so that *Bryum* is a source of discouragement to nearly every amateur who attempts to study it. Authentic specimens are often a necessity, even to the most experienced.

The border often varies on the same leaf. Lower leaves of *Bryum* are usually shorter and broader than the upper leaves and always have a shorter costa. The inner comal leaves are usually larger and narrower than the general run of leaves on the plant. The border of a *Bryum* leaf is usually most distinct near the base and least distinct near the apex. In using the key, select leaves in the lower part of the upper third of the leafy portion of the stem and look for border in the upper third of the leaf. The margin of the leaves is frequently strongly recurved and gives the appearance of a margin whether a margin be really present or not. To make sure, the margin must be flattened out by manipulation with needles and pressure on the cover-glass. It may even be necessary to use scissors.

Some of the species vary in the characters used in the key, hence these species have to be included under more than one of the headings.

A sterile *Bryum* is a practically insoluble problem and should not be attempted by any except the bryologist of long experience; nor should the student attempt to get others to solve such problems unless for some exceptional reason. The key which is given below is an attempt to enable one to work out our species by the most accessible characters, but this will often be found inadequate because of exceptional variation. The contraction of the capsule below the mouth is of value in mature plants only, for only slightly immature capsules of almost any of our species will contract under the mouth in drying.

Besides the easily recognized *B. argenteum*, the student of *Bryum* will collect *B. caespiticium* and *Pohlia nutans* on every trip, until he despairs of finding anything else. The former will be found on dry soil and the latter in moist places. The elongated sublinear leaf cells of *Pohlia* will serve to distinguish it from *Bryum*.

The leaves on fruiting *Bryums* are frequently so badly decayed as to make study difficult, and for the same reason it is often hard to make out the position of the antheridia. This seems to be due to the fact that it takes many

species of *Bryum* nearly or quite a year to mature the sporophyte. On specimens of *B. bimum* and also of *B. caespiticium* I have found, early in August, freshly matured capsules with opercula, and also fertilized archegonia and young sporophytes.

Height as used in keys and descriptions applies to the gametophyte only. The leaves in *Bryum* are markedly smaller than in *Mnium*, and the leaf cells are much more elongated. The capsules are usually more slender, longer necked and more pendent.

Pohlia (*Webera* of the L. & J. Manual) is so much like *Bryum* that a word of warning may not be out of place here. The leaf cells in *Pohlia* are much longer than in *Bryum*. *B. capillare* is frequently mistaken for *Mnium* because of its short leaf cells.

KEY

1. Leaves bordered 2.
 Leaves not bordered, at least in the upper half 12.
2. Costa plainly vanishing below apex. (See also *B. capillare*) 3.
 Costa percurrent or excurrent in some of the leaves 4.
3. Upper leaves orbicular, obtuse *cyclophyllum*.
 Upper leaves acute, with long-decurrent wings *Duvallii*.
4. Leaves very strongly and broadly decurrent; plants slender; capsule
 long-necked, usually unsymmetric *pallens*.
 Leaves not decurrent, or, if so, plants robust or capsules short-necked 5.
5. Teeth of peristome with oblique or vertical lines connecting the trans-
 verse articulations (See Fig. 110); inner peristome without cilia,
 somewhat adherent to the outer *pendulum*.
 Teeth of peristome without unusual markings; cilia lacking or rudi-
 mentary, not appendiculate; all rare 6.
 Teeth of peristome without unusual markings; cilia 2-4, nearly as long
 as the segments, usually appendiculate 7.
6. Capsules unsymmetrical, mouth oblique *uliginosum*.
 Capsules symmetrical *inclinum*.
7. Costa long excurrent; dioicous. (See *B. capillare*) *caespiticium*.
 Costa long excurrent; synoicous 8.
 Costa long excurrent; autoicous *pallens*.
 Costa percurrent or shortly excurrent 9.
8. Capsules sometimes unsymmetric; operculum small and persistent;
 leaves not decurrent *intermedium*.
 Capsules symmetrical; lid larger; leaves decurrent *affine*.
9. Leaves decurrent 10.
 Leaves not decurrent; dioicous 11.
10. Synoicous *bimum*.
 Dioicous *pseudotriquetrum*.
11. Capsules short and thick, strongly contracted below the wide mouth
 when dry; leaves short acuminate *turbinatum*.
 Capsules hardly contracted below the mouth when dry; leaves rather
 abruptly long acuminate *capillare*.

12. Costa plainly vanishing below apex 13.
 Costa excurrent or percurrent 14.
13. Branches julaceous, plants silvery and shining when dry, common in
 paths and waste soil *argenteum*.
 Branches not julaceous; leaves green, larger at summit of stem, forming
 a tuft. A rare alpine moss *calophyllum*.
14. Stems slender, filiform, julaceous; wet rocks in mountain streams; rare. *concinnum*.
 Stems not julaceous 15.
15. Costa excurrent into a long point 16.
 Costa shortly or not at all excurrent 17.
16. Synoicous *intermedium*.
 Dioicous *caespiticium*.
17. Costa scarcely or not at all excurrent; tufts dense and wide, glossy red
 and green; capsule red-brown. Wet rocks in mountains; rare and
 beautifully colored *alpinum*.
 Costa distinctly excurrent; tufts thin; ripe capsule purple-red . . . *atropurpureum* (*bicolor*).

The following divisions into subgenera and groups will be found helpful in identifying the species; for the beginner it may be well at first to try to do little more with some forms than to refer them to the proper group.

SUBGENUS 1. CLADODIUM

Inner peristome more or less adherent to the outer, with cilia lacking or rudimentary; when present the cilia are not appendiculate.

Section 1. Ptychostomum

Outer teeth with irregular oblique or vertical lines on the inner surface, connecting the transverse articulations of the lower portion of the teeth.

B. pendulum (Hornsch.) Schimp. is our only member of this section. It is distinguished from closely related species by the characters given under subgenus and section. Sometimes the inner peristome separates from the outer, and the slender segments, widely split along the median line, look like large cilia. The plants are usually synoicous, sometimes subautoicous. The spores mature in spring or early summer. Sterile specimens of *B. inclinatum* cannot with certainty be separated from this species. *B. caespiticium* without antheridia is hard to distinguish, except for its free inner peristome and appendiculate cilia. If one overhauls his specimens of *inclinatum* and *caespiticium*, he is likely to find specimens of *pendulum*, which is clearly distinct by the longitudinal markings on the teeth.



FIG. 110.
Tooth and
adherent seg-
ment of *Bryum*
pendulum.

Section 2. Eucladodium

Differing from Section 1 in the lack of oblique or vertical markings between the articulations of the teeth. The species of this section are rare and seldom collected.

B. inclinatum (Sw.) Bland. except for the differences noted above, is almost identical with *pendulum*. Spores in summer. Rare with us, common on the Pacific slope according to the L. & J. Manual.

B. uliginosum (Bruch) B. & S. Autoicous. Somewhat like the last, but leaves not so narrowly pointed and costa not so long excurrent; capsules strongly unsymmetric and incurved, mouth small and one-sided; neck long, narrow and tapering; spores in late summer. Rare.

B. calophyllum R. Br. Leaves roundish ovate to suborbicular, concave, entire, obtuse or obtusely apiculate, not bordered; costa ending below apex; or rarely reaching it; autoicous; spores in summer and autumn. Very rare; Franconia Mountains, N. H.

SUBGENUS 1. EUBRYUM

Peristome perfect, inner free from outer, cilia nearly or quite as long as segments, appendiculate. Spores smaller than in *Cladodium*.

Section 1. Leucodontium

Teeth of peristome pale yellow throughout, base of teeth scarcely thicker. (Though European authors emphasize the color of the teeth, I am unable to make much use of it.)

B. cyclophyllum (Schwaegr.) B. & S. Leaves suborbicular, *all obtuse and concave, weakly bordered*; costa ending below apex. Resembles *B. calophyllum*, but is distinguished by the italicized characters, and by the perfect cilia. In wet places, rare. Niagara Falls, Pennsylvania, etc.

B. Duvallii Voit. is a rather rare species growing in or near water in mountainous regions. It is dioicous, with antheridial heads discoid, and is so lax and slender, with leaves so distant, that it might almost be mistaken for an *Amblystegium* or other subaquatic hypnaceous moss. It is at once recognized by the very strongly decurrent ovate to lanceolate leaves, as shown in Fig. III. The leaves are entire and bordered by about two rows



FIGURE III.
Portion of stem of *Bryum Duvallii*
much enlarged (From Bry. Eur.)

of narrow cells, and have the costa ending below the apex. The capsules mature in late summer. This is one of the species that can easily be determined sterile. The next is the only one likely to be mistaken for it. In that species, however, the costa is excurrent and the leaves are not quite so strongly decurrent.

B. pállens Sw. is an interesting alpine or subalpine species, not common, but so well marked as to be distinguished readily. The fresh plants are

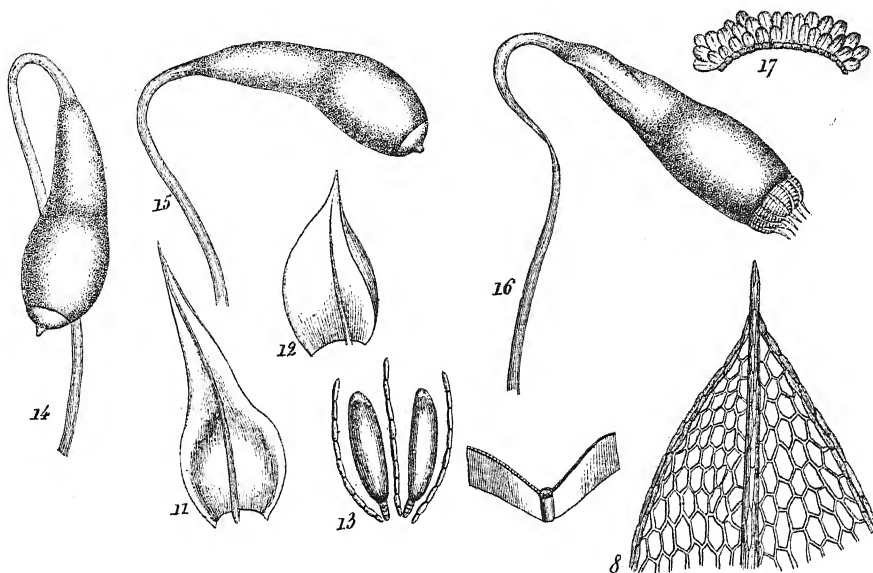


FIGURE 112. *Bryum pallens* (From Bry. Eur.). 11 and 12. Perigonal leaves. 8. Leaf apex.

usually some shade of red; the leaves are strongly decurrent, short pointed, with a reddish costa much as in *B. bimum*; border well defined, revolute. Dioicous: capsule slightly curved, with a long neck, approaching in form that of *Leptobryum pyriforme*, but larger; teeth not darker at base than at the apex; spores in summer. On soil. The capsule somewhat resembles that of *B. uliginosum*, and serves to distinguish this from species with which it might otherwise be confused.

B. turbinatum (Hedw.) Schwaegr. is another very rare species reported from Niagara Falls, the Rocky Mountain regions; N. H., James and N. J., Austin. The leaves resemble those of the last, but are not so strongly decurrent. The capsules are the characteristic thing. They are symmetric and short pyriform. When dry and deoperculate the mouth flares out, while the capsule immediately below the mouth becomes very strongly contracted, below this the capsule widens and finally tapers rapidly into the neck. This also is dioicous.

Section 2. *Pseudotriquetra*

Plants robust (for the genus), with strongly decurrent leaves, which are rather sharply acuminate; costa usually excurrent, and leaf apex or excurrent costa serrate or toothed; peristome thickened and reddish at base. This last character is often obscure.

B. bimum Schreb. is, next to *B. caespitium* and *B. argenteum*, our most common species. It is common in wet places of almost every description. The plants vary a great deal in robustness, in the var. *elatum* reaching a height of 5 inches. The stems are matted together by a felt of red-brown radicles. The leaves are long, up to 3^{mm}, decurrent; when dry "usually shrunk, somewhat twisted or appressed, oblong-lanceolate or lanceolate"; costa red, percurrent or excurrent; margins strongly revolute nearly to apex; three or four rows of marginal cells much longer and narrower, forming a distinct border which is less conspicuous near the apex. Synoicous: spores maturing in summer.

"A fine species not likely to be confounded with any other except *B. pseudotriquetrum*, on account of the robust habit, the large leaves with short points, and large long capsule on a tall seta, and the synoicous inflorescence."—Dixon.

B. pseudotriquetrum (Hedw.) Schwaegr. differs from the preceding essentially in nothing but in being dioicous. It has the same range and is sometimes found growing with it. The leaves are more rigid and less shrunk and contracted when dry, and the capsules are more ventricose, but these differences are not constant.

B. affine (Bruch) Lindb. (*B. cuspidatum* Schimp.) is a rather infrequent species not included in the Lesq. & James Manual. It is close to *B. bimum*, from which it differs in its smaller size, less strongly decurrent leaves with a much longer excurrent costa. It is so close to several other species as to be exceedingly difficult to identify satisfactorily. From *B. intermedium* it differs in its decurrent leaves with a more strongly marked border and in the longer capsules, somewhat contracted below the mouth when dry. It is synoicous, which distinguishes it from *caespitium* and *pallenscens*. It grows on damp rocks and walls, and matures its spores in summer. So far as my observation goes, the costa in *pallenscens* and *affine* is a dark purplish red at base when the leaves are old, as in *B. bimum*. In *caespitium* the costa may become reddish, but I have never seen it of such a deep pronounced color.

Section 3. *Cæspitibryum*

Plants usually smaller than in the last section; leaves not decurrent, long acuminate, with costa excurrent. Peristome as in the last section.

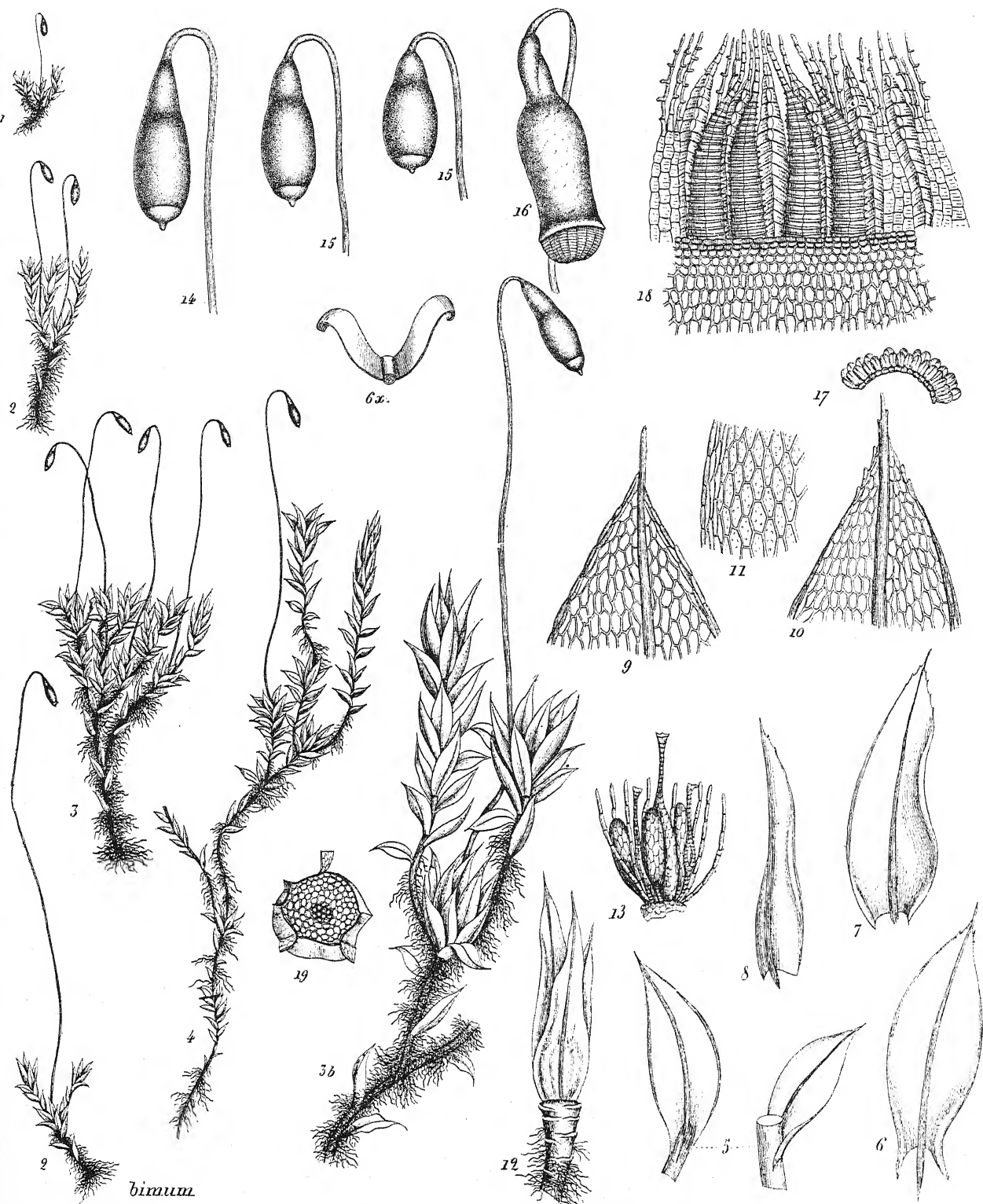


PLATE XLVII. *Bryum bimum* (From Bry. Eur.)

5082
30

183127

B. palléscens Schleich. is intermediate between this section and the last. It is so much like *B. affine* that Dixon considers it as one of the subspecies of *ventricosum* along with *affine* and *bimum*. From *affine* it differs in its non-decurrent leaves and autoicous "inflorescence." This is a rare species growing chiefly in elevated regions.

B. cæspiticiu L. is perhaps the most common of all our species, being found in rather dry soil in all kinds of situations, and on rocks and walls.

It is a type of a large group of species which are difficult to distinguish from it and from each other. The plants are densely tufted, averaging less than half an inch in height, said to occasionally reach an inch; leaves ovate-lanceolate, imbricated, but hardly twisted when dry; margin revolute to near the summit, bordered by very narrow marginal cells which are scarcely apparent at the extreme apex; costa long excurrent in the upper leaves, slightly or not at all toothed. *Dioicous*: capsule horizontal or more frequently drooping.

The spores

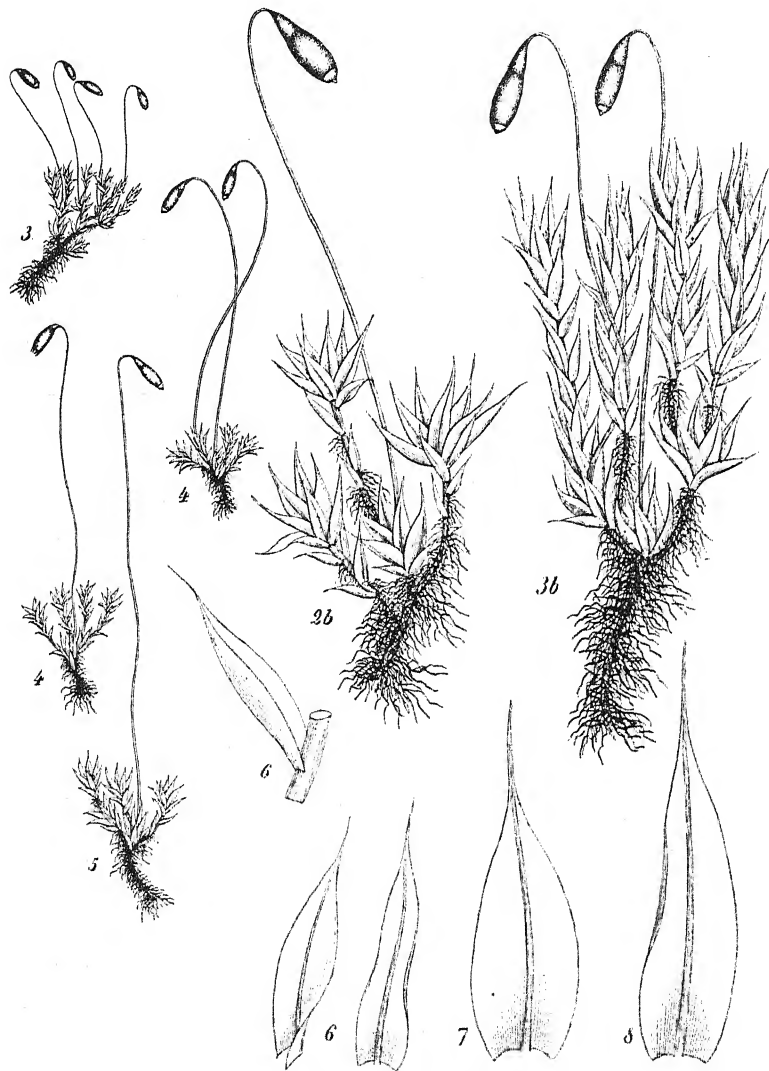


FIGURE 113. *Bryum cæspiticiu* (From Bry. Eur.). 3, 4 and 5. Plants natural size. 2b and 3b. Plants magnified. 6, 7 and 8. Leaves.

mature in spring and summer. It takes at least a full year for the sporophyte to develop, for I have found antheridia and archegonia at the same season when the capsules were coming to full maturity.

B. intermedium Brid. is so much like *B. caespitium* as to be very troublesome. It is *synoicous*, with shorter, more pendent capsules. It is much less common and prefers moister situations. Dixon says that the spores mature later, but I am not able to verify this in American specimens.

The operculum is smaller and much more persistent. In many of the specimens I have examined the dry capsules have a narrower neck, rather abruptly expanding into the spore-bearing part of the capsule.

Section 4

The peristome in the following species has the characteristics of the two preceding sections. In this section I have put species which did not fit into any of the others.

B. capillare L. is a species likely to be mistaken for a *Mnium*, as it is *Mnium*-like in habit and in shape and structure of leaves, but the capsule is typically that of *Bryum*, with neck one-half as long as the rest of the capsule, or longer. The leaves are spirally twisted when dry; the costa is long excurrent in the uppermost leaves, but often fails to reach the apex in the lower leaves, and it seems to be bordered on the back next the lamina with large inflated cells, at least near the base. On rich loamy soil in woods; often on soil overlying ledges; frequent. The spores mature in August. Usually dioicous.

B. alpinum L. is an exceedingly robust species, so much so that when dry it somewhat resembles some of the smaller species of *Polytrichum*. The plants are 3-9cm high, with very rigid robust stems, and grow in compact tufts on wet ledges and rocks in the alpine regions of the White Mountains. They are a deep dark red when dry, or variegated red and green in the younger portions; when fresh the colors are brighter. Leaves loosely imbricated when dry, oblong-lanceolate, acute, concave, margins reflexed; costa nearly or quite

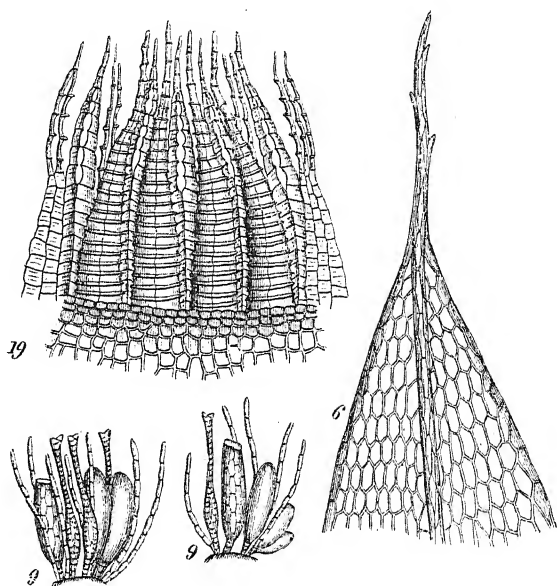
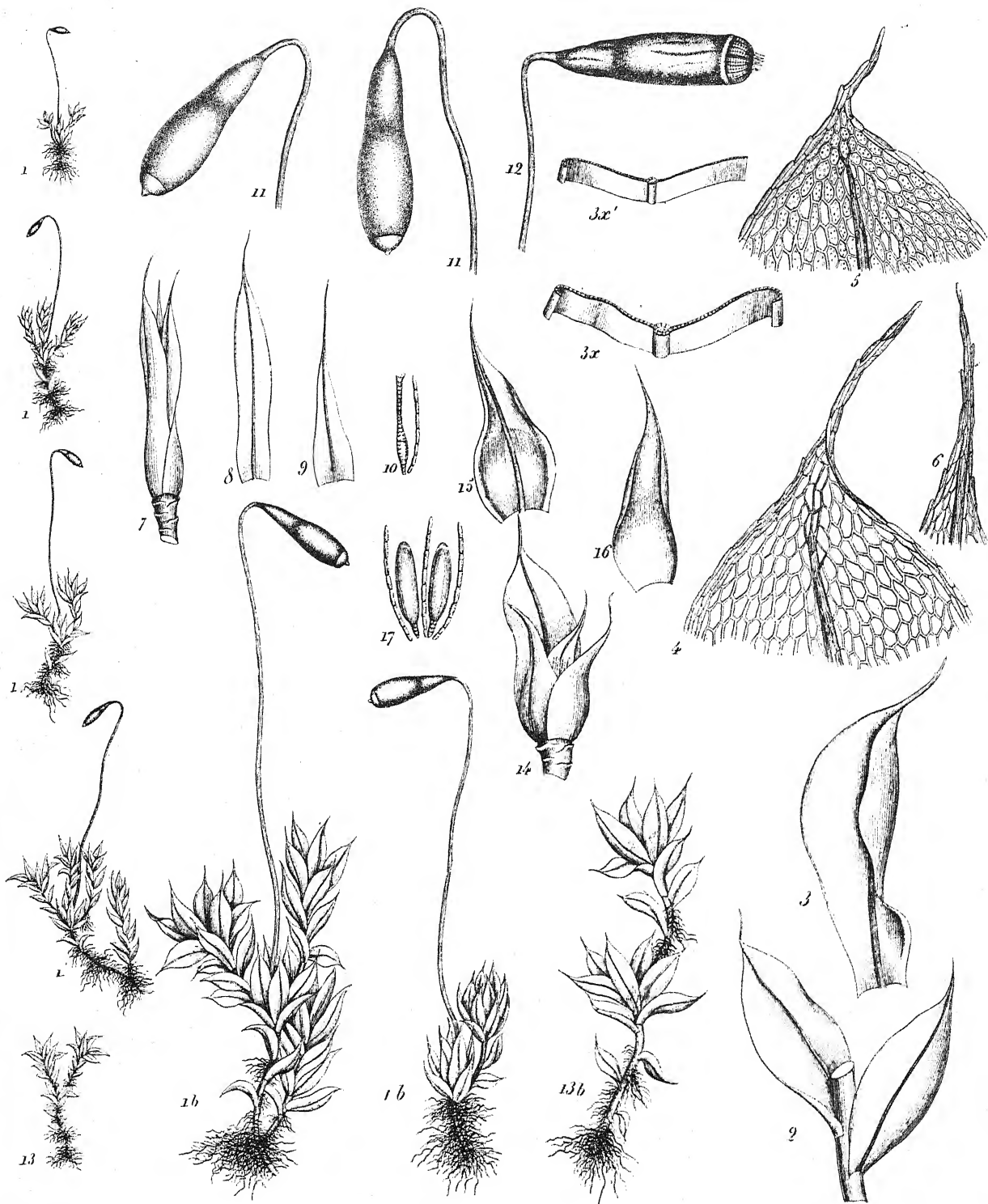


FIGURE 114. (From Bry. Eur.) Peristome, leaf apex and synoicous "inflorescence" of *Bryum intermedium*.



capillare

PLATE XLVIII. *Bryum capillare* (From Bry. Eur.)

percurrent; leaf cells so narrow as to be more like *Pohlia* than *Bryum*, thick-walled: dioicous; capsule deep red.

B. atropurpureum Wahlenb. is a much smaller and less brilliantly colored species having the costa excurrent, the leaf margins revolute and leaf cells of the typical *Bryum* shape: dioicous; capsule short, oblong or obovate. The revolute margins make the lower edge of the leaf appear as if margined, unless carefully examined. This species is not alpine, but is rather infrequent. Spores in early summer. This might be mistaken for the ever-present *caespitium*, but for the more shortly excurrent costa and short, oblong or obovate capsule.

B. argenteum L., the Silvery Bryum, is a small species

growing everywhere in dense mats, resembling the pile of an exceedingly coarse natural velvet. It is especially fond of dry compact soil in sandy fields and waste places. It grows abundantly in paths and between the bricks of sidewalks in towns and cities. When fully grown it is a bright silvery gray, due to the fact that the leaves are white and without chlorophyll when old.

The young plants are green and may easily be mistaken for something else. The leaves end in a slender bristle and are crowded and closely overlapping, making the stems and branches prettily julaceous.

The leaves are broadly ovate or obovate, not bordered, with costa ending considerably below the apex; margins plane and entire. The capsules mature in autumn, but can be found in recognizable condition at almost any season. When fully mature the seta and capsules are dark red.

On damp soil and stones in the cliffs of elevated regions, there may be found two mosses of the *Bryum* family that remind one of *Bryum argenteum*. They are slender and julaceous, but are not difficult to distinguish from it.

Plagiobryum Zieri (Dicks.) Lindb. perhaps resembles it most closely when sterile, but it usually has a reddish tinge, the capsule has a neck once to twice the length of the rest of the capsule, the mouth is oblique and on the under side after the manner of the mouth of the capsule in *Funaria*; the costa extends into the base of the leaf point, and the leaf cells are hexagonal-rhomboid and nearly twice as large.

Anomobryum concinnum (Spruce) Lindb. is a bright glossy green, its stems

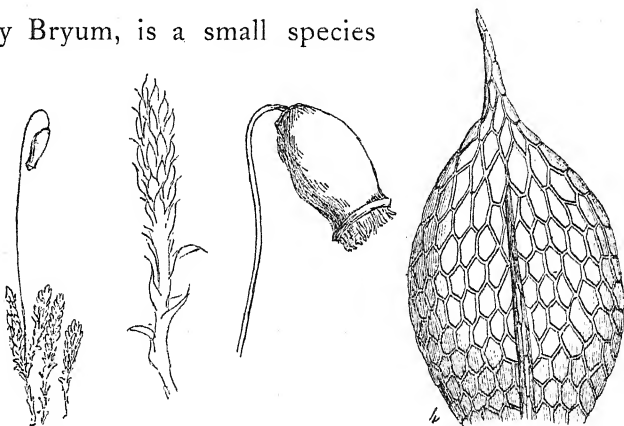


FIGURE 115. *Bryum argenteum* $\times 4$; branch $\times 10$; capsule $\times 20$. 4. Leaf greatly magnified (From Bry. Eur.)

are longer, the leaf cells are very much narrower, linear-vermicular; costa usually percurrent; capsules unknown.

The habitat alone is sufficient to distinguish these two mosses from *B. argenteum*, and the difference in leaf cells is enough to distinguish these from each other.

RHODOBRYUM (Schimp.) Hampe.

Nearly always dioicous. Very large plants, sending out subterranean stolons from which other plants are produced.

R. roseum (Weis.) Limpr., the Giant Bryum, is the largest and showiest of all our species of this family, and, moist and fully expanded, is a striking object in any situation.

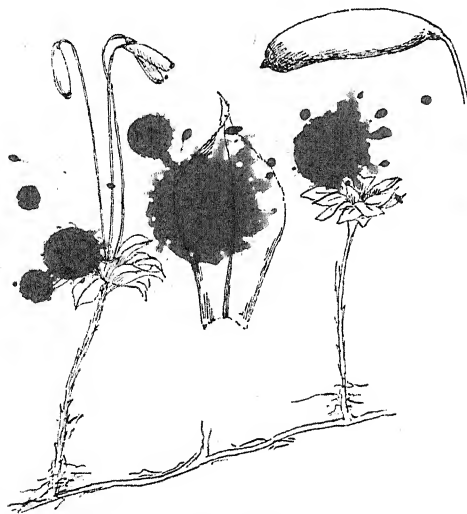


FIGURE 116. *Rhodobryum roseum* $\times 1$;
leaf and capsule $\times 4$.

The stems spring from stolons and are nearly leafless except at the summit, where the very large leaves form a rosette. Under favorable circumstances it forms a mat. It is found in low wet places, especially in the shade of trees in rich peaty soil. Although common, it fruits infrequently in either America or England, but reproduces freely by its stolons.

The antheridia mature in late August or early September, and the male heads are so large and conspicuous that it is easy to find them in almost any locality where the species grows. The antheridia are so large as to be easily seen with a hand-lens. One who has access to a compound microscope should not fail to study the antherozoids with high powers. The spores

mature in autumn. This species is much like a *Mnium* in general appearance, but is larger than any of our species. The large terminal rosettes and elongated leaf cells, like those of *Bryum*, will serve to identify it.

SUBFAMILY 2. MNIEAE

Plants usually larger than in Subfamily 1, with larger broader leaves. Leaf cells nearly as broad as long. Plants rarely branching by innovations below the "flowers," frequently stoloniferous, *i. e.*, with prostrate or creeping sterile shoots that root at their tips. Capsules usually without appreciable neck; stomata usually immersed or partially so, rarely completely superficial.

- | | |
|---|--|
| 1. Leaves not bordered | 2. |
| Leaves bordered | 3. |
| 2. Plants large, leaves entire or very slightly serrate by projecting cells; leaf cells twice as long as broad, marginal cells linear | <i>cinclidioides</i> . |
| Plants much smaller, leaves usually serrate; leaf cells isodiametric (<i>i. e.</i> , as broad as long) | <i>stellare</i> . |
| 3. Leaves entire | 4. |
| Leaves serrate, with single teeth | 7. |
| Leaves serrate, with teeth in pairs | 11. |
| 4. Leaves costate to apex | <i>punctatum</i> . |
| Costa vanishing below apex | 5. |
| 5. Upper leaf cells isodiametric | <i>hymenophylloides</i> . |
| Upper leaf cells longer than broad | 6. |
| 6. Margin of leaves thickened, of 2-4 layers; dioicous; capsules oval | <i>punctatum</i> ,
var. <i>elatum</i> . |
| Margin of leaves not thickened; synoicous; capsule subglobose | <i>subglobosum</i> . |
| 7. Leaves serrate to base or nearly so; capsules clustered | 8. |
| Leaves serrate in the upper $\frac{1}{2}$ or $\frac{2}{3}$ only | 10. |
| 8. Teeth of leaf margins of 2-5 cells (except <i>affine rugicum</i>); operculum mammillate or apiculate | 9. |
| Teeth of leaf margins very short; operculum strongly beaked | <i>rostratum</i> . |
| 9. Dioicous; many marginal teeth of more than two cells | <i>affine</i> . |
| Synoicous; marginal teeth shorter, few of more than two cells | <i>medium</i> . |
| 10. Capsules clustered; leaves little shriveled in drying | <i>Drummondii</i> . |
| Capsules single; leaves strongly shriveled when dry | <i>cuspidatum</i> . |
| 11. Costa vanishing below apex | <i>hornum</i> . |
| Costa reaching apex in upper leaves | 12. |
| 12. Costa toothed on the back; dioicous | <i>orthorrhynchum</i> . |
| Costa not toothed on the back; synoicous | 13. |
| 13. Capsules sometimes clustered; peristome forming a conspicuous red-brown band around the mouth of the deoperculate capsule | <i>spinulosum</i> . |
| Capsules not clustered; peristome yellowish | <i>marginatum</i> . |

A. Serrate. Leaves bordered, serrate with single teeth.

M. cuspidatum (L.) Leyss. (*M. sylvaticum* Lindb.), Woodsy Mnium. One of the first signs of vegetable life in early spring is the array of upright green sporophytes of the Woodsy Mnium, which is common in lawns and parks in moist shady corners, and is to be found abundantly in moist woods everywhere, growing sometimes on the soil, sometimes on rotten wood. The sterile shoots are prostrate or suberect and the leaves decurrent and shaped as in Fig. 117, *e*, all acute, strongly bordered and serrate in the *upper half* or *two-thirds* with one-celled teeth, occasionally there may be teeth of two cells;

costa stout, vanishing in or just below the cuspidate apex, often confluent with the border and appearing excurrent; leaf cells hexagonal, small, varying from about 20μ near the apex to 25μ near the middle of the leaf, somewhat collenchymatous. Synoicous; capsules single, maturing in May, but remaining in recognizable condition until August.

M. affine ciliare (Grev.) C. M., the Toothed Mnium, superficially resembles the last, and next to it is our most abundant species. It is larger and *serrate to the base with long slender teeth* composed of 2-4 cells except at the very base. No reliance should be placed on the shape of the leaves as a mark of distinction between these species, as the leaves vary greatly even on different parts of the same plant, as may be seen in Plate XLIX.

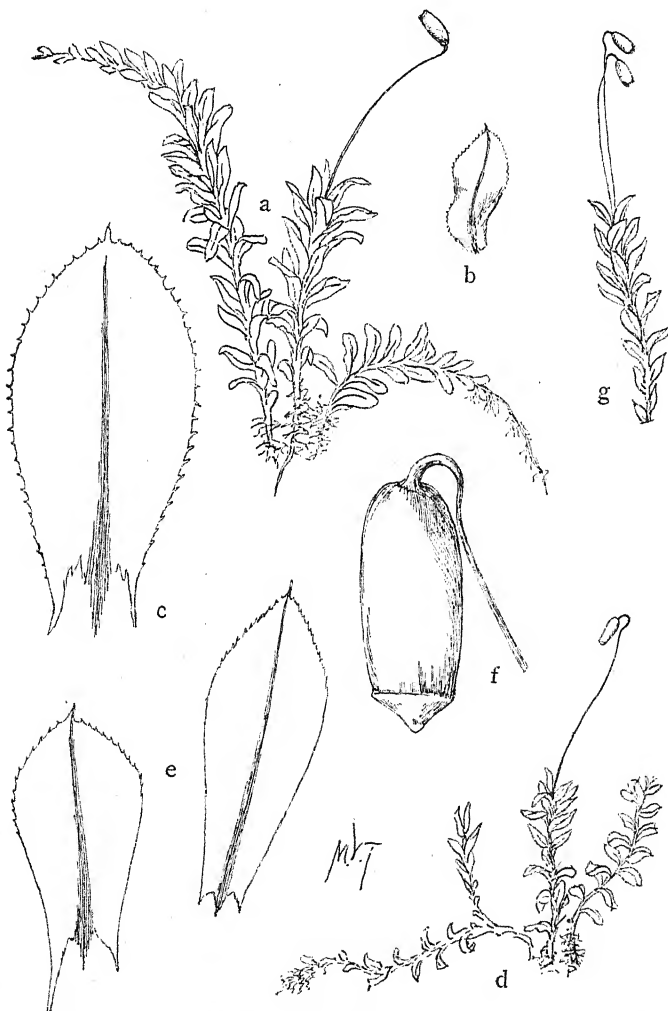
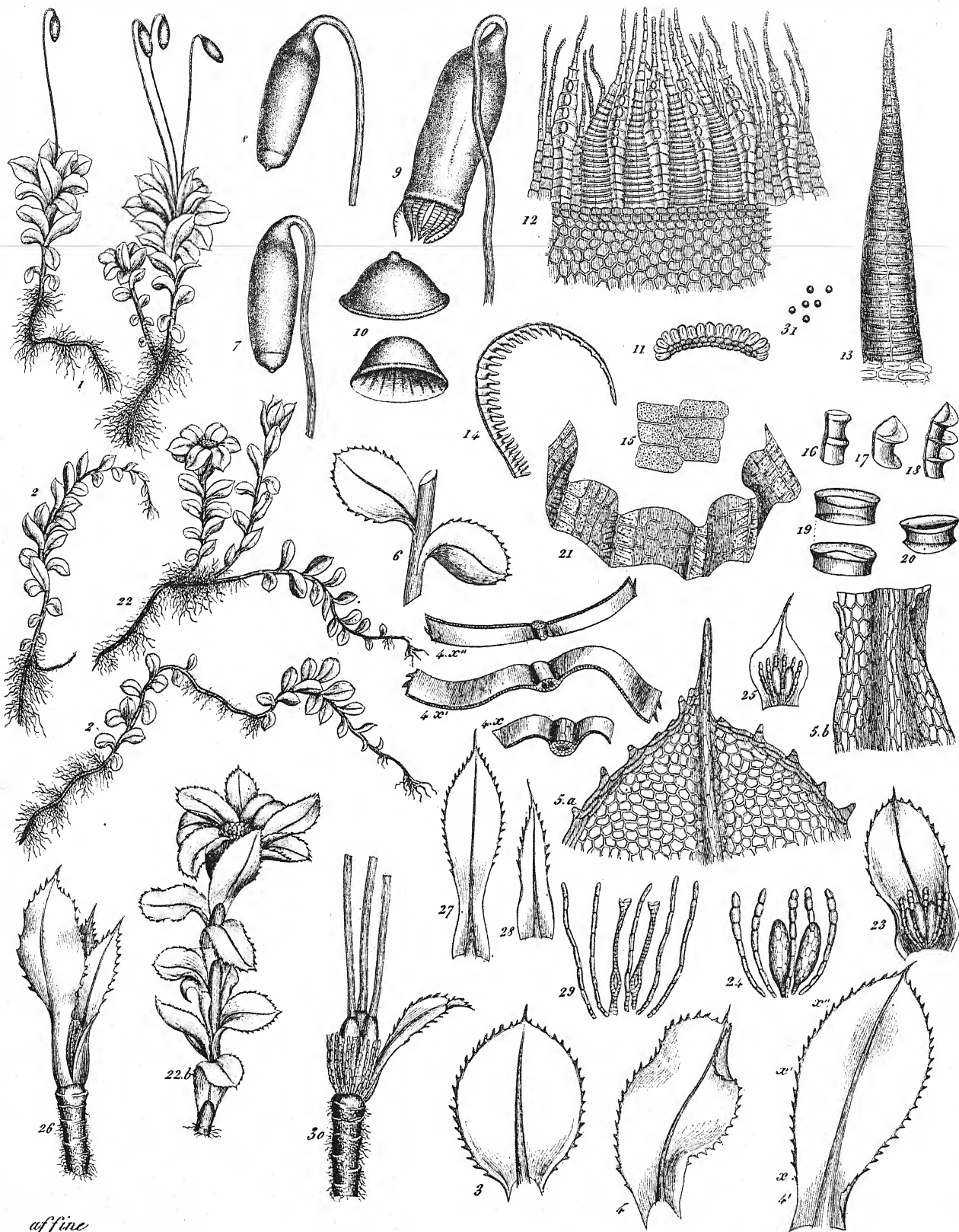


FIGURE 117. a. *Mnium affine ciliare* $\times 1$. b. Leaf $\times 4$. c. Leaf $\times 10$. d. *M. sylvaticum* $\times 1$. e. Leaves of different shapes $\times 10$. f. Capsule $\times 10$. g. *M. affine* $\times 1$.



affine

PLATE XLIX. *Mnium affine* (From Bry. Eur.)

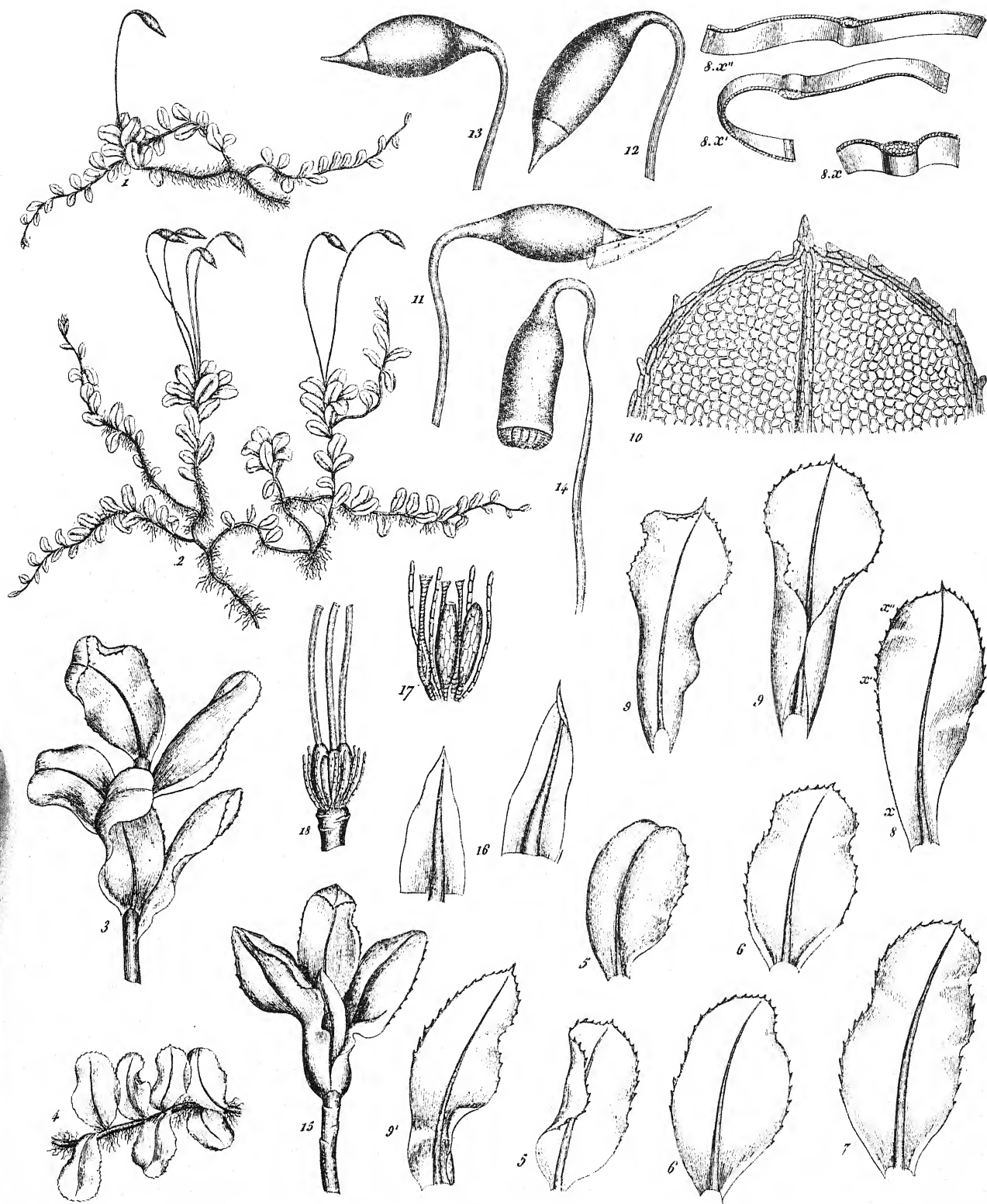


PLATE L. *Mnium rostratum* (From Bry. Eur.)

The leaf cells are nearly twice as large as in the last, 25-40 μ , somewhat longer than broad, sometimes reaching 70 μ in length according to Limpricht. *Dioicous*; capsules usually single, maturing in May.

M. affine Bland. The common form of this species is the variety described above. The species is rather rare and is a more puzzling form for the student. It has the capsules clustered, and teeth on the margins of the leaves shorter than in the Toothed *Mnium*.

M. affine rugicum B. & S. is a puzzling plant, with leaves strikingly different from the species in extreme forms. They are shorter, broadly oval or oblong, to suborbicular on the sterile shoots, and little or not at all serrate; the apex is as rounded and short apiculate as in *rostratum*. (See that species for distinctions.) The plants are smaller than in the species and of a darker, almost blackish green, except at the growing tips.

M. medium B. & S. is very close to *affine*. It is usually larger, *less shriveled when dry*; marginal teeth of leaves shorter and of fewer cells; *synoicous*; operculum longer apiculate. Because this species is *synoicous* it is often mistaken for *Drummondii*, but in that species the leaves are not serrate to the base. Not common but widely spread; maturing spores at the same time as *affine*.

M. rostratum Schrad. is a third large stoloniferous species with clustered capsules, leaves margined and serrate with a single row of teeth. The leaves are broadly oblong, rounded at both ends, less tapering at base and less decurrent than in the preceding, apiculate by the percurrent costa as shown in Plate L. The margins are very wide and strong and the *marginal teeth are short and mostly of one cell* and do not extend so near the base as in *affine* and *medium*; leaf cells about the size of those in *affine* but *thicker walled* and plainly collenchymatous: *synoicous*; *operculum long-beaked*; spores maturing in early spring. The italicized characters readily differentiate this from all of the preceding except forms of *affine* approaching *rugicum* and that variety itself. These forms of *affine* are usually darker colored with thinner walled leaf cells that radiate in apparent rows from the costa in a manner not noticeable in *rostratum*. In perfect fruit the long rostrate operculum clearly distinguishes this from any of its allies in our range.

M. Drummondii B. & S. is a rather infrequent species, sometimes confused with *affine* but easily distinguished by the fact that, like *cuspidatum*, its leaves are serrate in the upper half only. The plants are smaller than in *affine*, the capsules are shorter and the marginal serrations consist of but one greatly elongated cell, as a rule. The leaves are broader and proportionately shorter than in either *affine* or *cuspidatum* and shrivel much less in drying. This last is so apparent that, after a little experience, specimens of *Drummondii* can be differentiated from the other two at a glance. The sterile shoots are mostly erect,

not creeping but sometimes arched at the tips. The much larger leaf cells, slender marginal teeth of the leaves, and clustered capsules, easily distinguish this from *cuspidatum*. It is synoicous and its spores mature in spring.

B. Biserrata. Leaves margined, serrate with double teeth.

M. spinulosum B. & S., the Red-mouthed Mnium, is another species somewhat resembling the Woodsy Mnium and growing in similar situations, but less common and usually growing in woods. The peristome is a very bright red-brown and after the operculum has fallen it makes a *very conspicuous red band about the mouth of the yellowish-white capsule*. If the leaves of the Red-mouthed

Mnium be carefully studied, the teeth on the margins will be seen to be in pairs.

The leaves are clustered toward the top of the fruiting stems in a manner very different from the loose and distant arrangement in the other species of this section; they are slightly shriveled when dry, obovate, to spatulate in the perichætium; costa percurrent, not toothed at back; leaf cells 20–30 μ in diameter, angled, *not colenchymatous*. Synoicous; capsules maturing at least two weeks later than those of the Woodsy Mnium. Before the lid has fallen its pronounced beak is an aid in identification. In Europe the capsules of this species are usually clustered, but in the eastern United States I find the great majority of plants with single capsules.

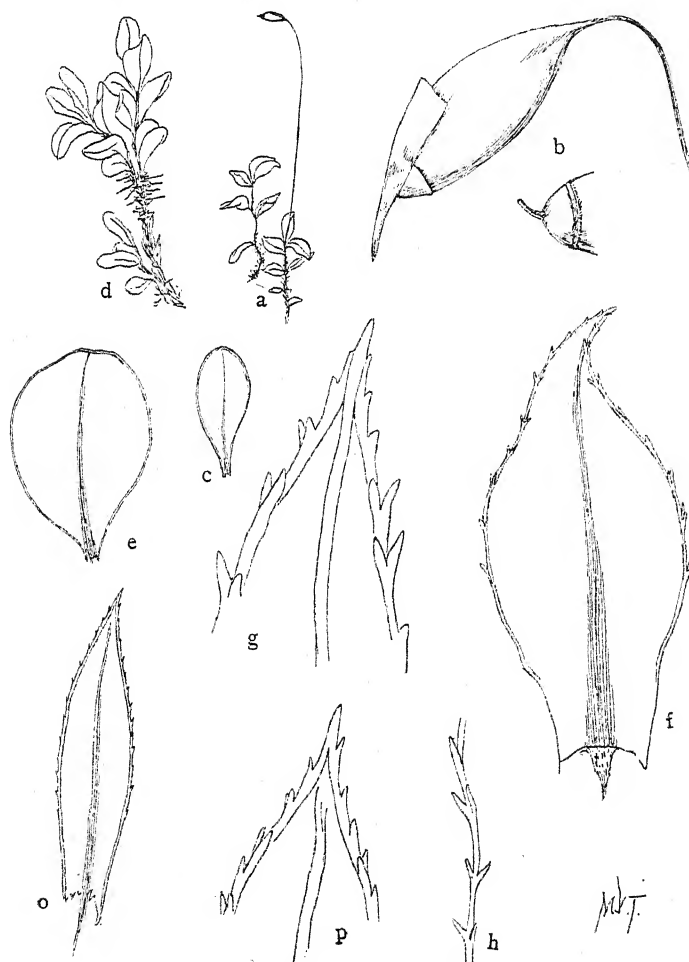


FIGURE 118. a. *M. punctatum* $\times 1$. b. Capsule and operculum $\times 10$. c. Leaf $\times 4$. d. Var. *elatum* $\times 1$. e. Leaf of var. *elatum* $\times 4$. f. Leaf of *M. spinulosum* $\times 20$. g and h. Apex and margin of same $\times 20$. i. Leaf of *M. hornum* $\times 10$. p. Apex of the same $\times 40$.

The plants also seem rather smaller than the western and European forms.

M. hornum L., the Long-leaved Mnium, has narrower leaves than is usual in the genus; *costa ending below the apex*, usually toothed on the back above; leaf cells about the same size as in the last, not collenchymatous. The operculum is conic and apiculate and the capsule has an apparent neck.

This species is dioicous and the disc-like male heads are an additional aid in identification. It is more abundant southwards and is frequent around New York City in shaded springy places. It does not appear to fruit freely, but if one can find fruit in April with the calyptra in its queer position on the seta, instead of on the capsule, he can make no mistake. (See Fig. 119.)

M. marginatum (Dicks.) P. Beauv. (*M. serratum* Schrad.). More slender than *M. hornum*, with rather broader leaves costate to apex in the upper portion of stem, long and narrowly decurrent, the wing often extending as far down as the next leaf; costa not toothed on the back; leaf cells 22–30 μ in diameter, irregular, rounded, strongly collenchymatous. Synoicous; operculum short-beaked; peristome brownish, sometimes so dark as to simulate the appearance of *M. spinulosum*. Crevices of rocks in moist places and margins of streams; not rare. *M. riparium* Mitt. is a rare and obscure species resembling *marginatum*, but dioicous and "with more distinct broader leaves, usually more quickly narrowed at base." Rockland Co., N. Y. and Bergen Co., N. J., Austin.

M. orthorrhynchum B. & S. is similar to the last, but has much smaller leaf cells, 15–18 μ , occasionally some of the largest as large as the smallest in *marginatum*; thick-walled, scarcely collenchymatous; costa toothed at back. Dioicous; peristome yellowish; operculum short-beaked; capsule with an apparent neck and more Bryum-like than in the species most like it, sometimes much more elongated than is shown in the plate. Spores in July and August. On moist rocks along streams in cool or elevated regions.

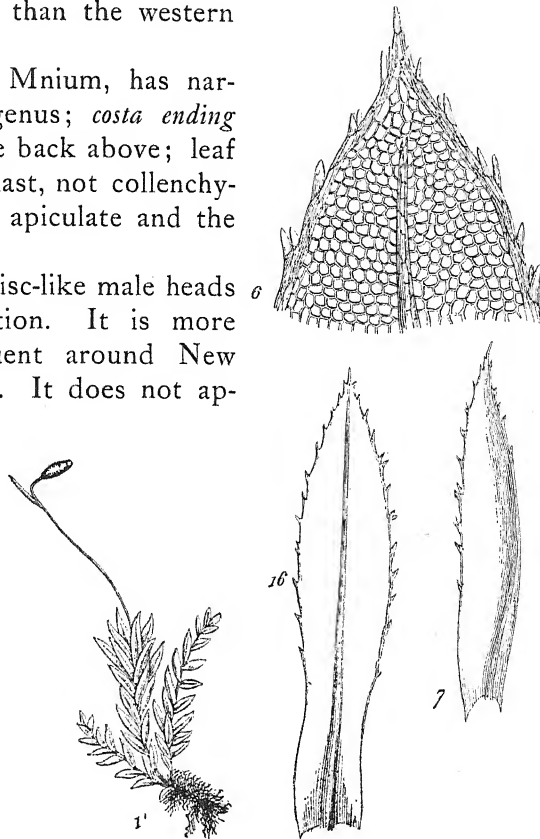


FIGURE 119. *Mnium hornum* (From Bry. Eur.).
1. Plant natural size. 6. Apex of leaf. 7. Leaf, side view.
16. Upper leaf.

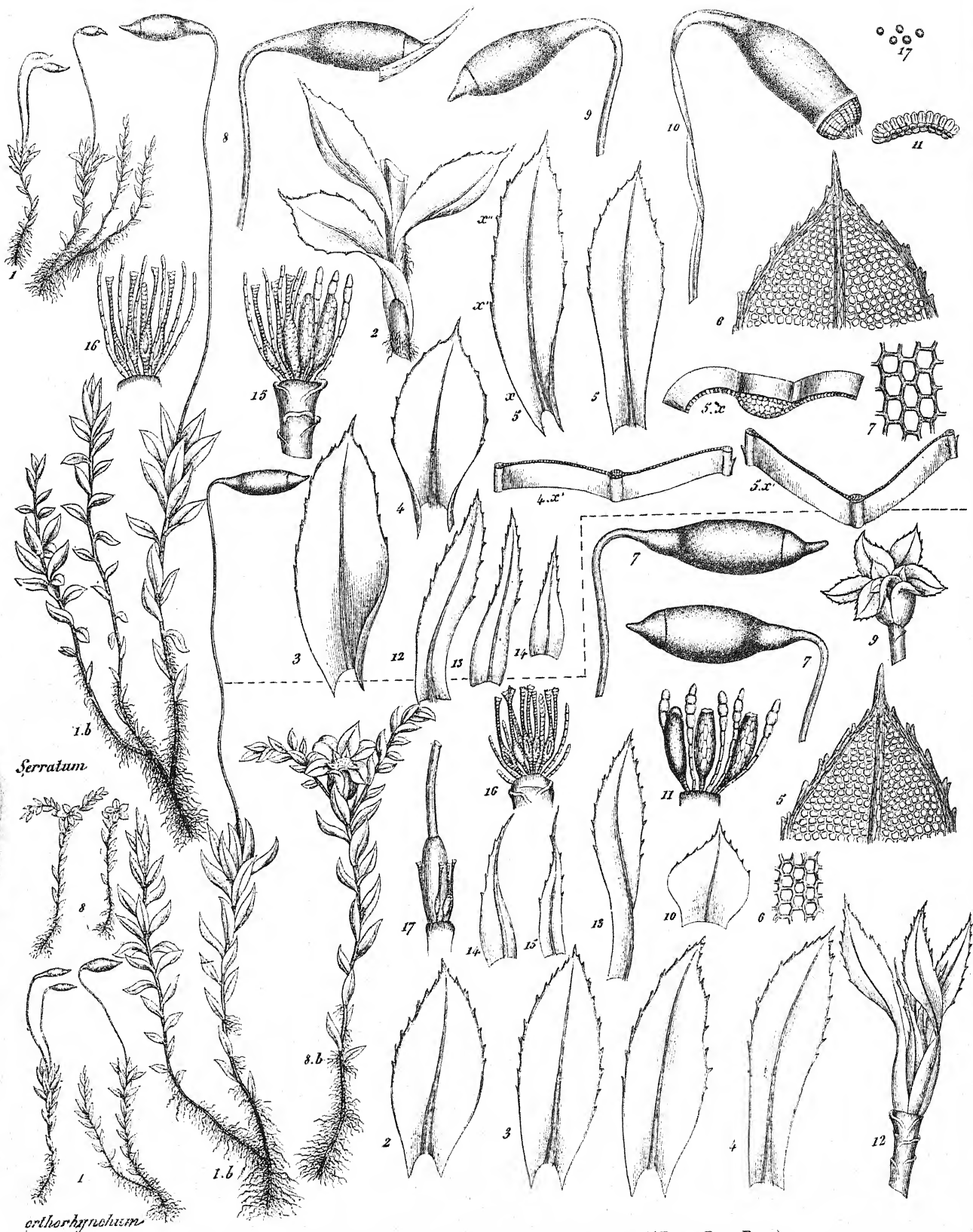


PLATE LI. *Mnium serratum* and *M. orthorrhynchum* (From Bry. Eur.)

In both *marginatum* and *orthorrhynchum* the costa in the lower leaves does not reach the apex and in the latter the lower leaves are often almost entire. Both species have the leaves a good deal shriveled when dry, especially on the sterile shoots.

C. Leaves bordered, entire.

M. punctatum L., the Early Mnium, grows on moist stones in the bed of brooks. It matures its capsules in April, long before any other species. It is at once recognized by its obovate margined entire leaves and beaked operculum. The leaves are usually minutely apiculate and the costa percurrent, although in some of the leaves it may stop just a little short of the apex. The margin is composed of 2-4 rows of cells in several layers. Dioicous. Common.

M. punctatum elatum Schimp., the Large-leaved Mnium, is said to be merely a variety of the Early Mnium growing in the mud in swampy places. It is often much larger than the figure, sometimes having leaves half an inch long. The leaf cells are so large as easily to be seen with a lens and in some cases with the naked eye of a trained observer. *Leaves not usually apiculate; costa ending below apex.* Very common in swamps, but not fruiting freely. (See Fig. 118.)

M. subglobosum B. & S. is a rare northern form found in our range in the extreme northern part only. In general appearance it very closely resembles the preceding, especially the var. *elatum*, but the margins are of one layer of cells, 1-3 cells wide; it is synoicous and the capsules are usually subglobose. As in *M. punctatum elatum* the costa ends below the non-apiculate apex.

M. cinclidioides (Blytt.) Hueben. is a very large moss 10 to 15 cm. high, said to have been found 3 dm. long, and looking almost exactly like an overgrown Large-leaved Mnium. The leaves are larger and oblong and are not margined after the manner of the preceding species of this section, but the marginal cells gradually become longer and narrower, the very outermost linear; *leaf margins entire*, except for an occasional slightly projecting cell. Dioicous. A rare species of cool bogs.

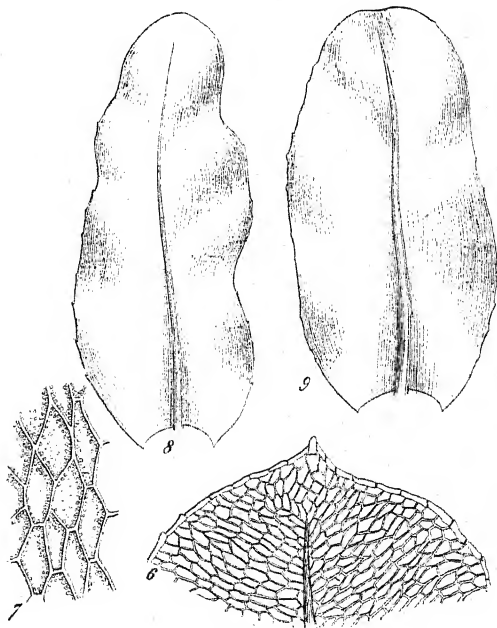


FIGURE 120. *Mnium cinclidioides* (From Bry. Eur.). 8 and 9. Upper leaves. 7. Leaf cells. 6. Leaf apex.

M. hymenophylloides Hueben. is a rare northern species found on cliffs in Vermont, New York and northwards. There is no authentic record of fruit, though archegonia have been seen. The leaves are *two ranked and mostly in one plane*, the lower rounded-ovate, the upper more elongated, ovate to obovate (uppermost elliptic-spatulate according to Limpricht), $2.5-3 \times 1.5-2$ mm., *strongly apiculate*; costa usually reaching apex; most of the leaf cells little if any longer than broad, only about half the size of the other species of this section.

D. Leaves not margined, serrate.

M. stellare Reich. is a small moss usually about 2 cm. high, though sometimes reaching 5 or 6 cm. It grows in rather dense cushions at the base of trees in swampy woods and, although frequent, it rarely fruits. The leaves are elliptic-oblong, not margined but serrate above. The costa ends farther below the apex than in any other species included here.

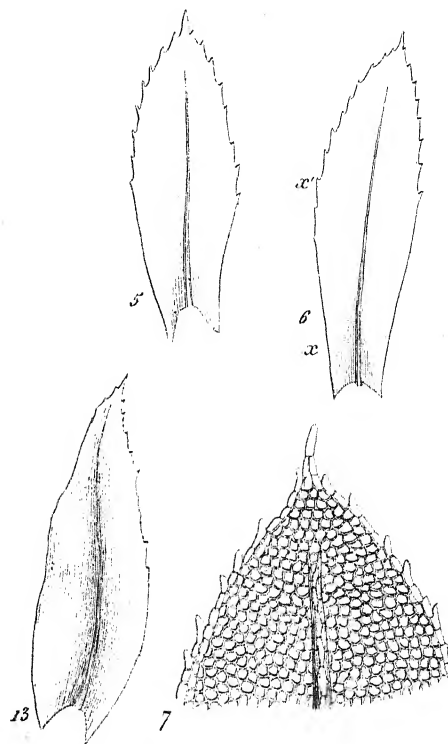


FIGURE 121. *Mnium stellare* (From Bry. Eur).
Leaves and leaf apex.

SUBGROUP 2. PLEUROCARPAE*

Sporophyte from a lateral bud on a branching prostrate or ascending plant; occasionally the plants are erect, as in *Climacium*. Peristome for the most part almost like that in the *Bryaceae*, except that in the *Hypnaceae* and some closely allied genera, the basal segments of the peristome teeth are ornamented by very fine transverse lines.

Family 21. Leskeaceae

Mosses of varying habit and size, growing on shaded earth, stones, trunks of trees, or decayed wood, usually lusterless; main stems creeping with ascending or erect secondary stems. In *Thuidium* the stems are regularly pinately branched and ascending, having somewhat the appearance of miniature

* For a more extended discussion of the classification of this subgroup, see *Revue Bryologique*, p. 73, 1899.

ferns. Stem leaves often very different from the branch leaves, both strongly costate in most species, costa never excurrent; leaf cells rarely more than three times as long as broad, often less, mostly papillose, papillæ often very large; leaf cells of the basal portion of the leaves more elongated and less strongly papillose, often smooth. Paraphyllia present in most species, varying in form but mostly slender and branched. Seta long, smooth, twisted when dry. Capsule erect and symmetric in most of our species, except in the genus *Thuidium*. *Thuidium* also has the perfect hypnaceous peristome, but most of the other genera illustrate well the degeneracy of the peristome in erect capsules, as explained on p. 28; the cilia are usually vestigial or lacking and the segments often very narrow, or, in some cases, imperfect.

I must acknowledge my very great obligation to Dr. Best for assistance with this family, which he has studied so long and much of which he has monographed in a most excellent manner. Some of the illustrations are from his monographs and portions of the text, though no quotation marks have been used.

KEY TO THE GENERA

1. Plants regularly and pinnately branching; capsules usually curved with perfect peristomes. (See also *Heterocladium*) *Thuidium*.
 Secondary stems usually ascending from prostrate main stems, not regularly pinnate; peristomes usually imperfect, and capsules erect and symmetric . . . 2.
2. Plants bluish or glaucous green (scarcely so in *Thelia hirtella*); leaf papillæ very large, often lobed or branched; paraphyllia lacking 3.
 Not bluish or glaucous green; papillæ smaller, or rarely lacking; paraphyllia present except in *Anomodon* and part of *Leskea* 4.
3. Costa short or double *Myurella*.
 Costa single, usually reaching the middle of the leaf *Thelia*.
4. Costa double or short or almost lacking. (See also *Leskea denticulata*) 5.
 Costa single, strong 6.
5. Leaves widely spreading when moist; capsule curved; peristome with cilia . . . *Heterocladium*.
 Leaves loosely imbricated when moist; capsule erect and symmetric; cilia lacking. *Pterigynandrum*.
6. ♀ buds and sporophytes borne on secondary stems; paraphyllia lacking *Anomodon*.
 ♀ buds and sporophytes borne on primary stems; paraphyllia present in part of the species *Leskea*.

THUIDIUM B. & S. The Fern Mosses*

The Fern Mosses are widely distributed and have been noted by every lover of out-of-door life because of their delicate and beautiful fern-like form. The branches are given off very regularly like the pinnæ of a fern, and the

*The species mentioned in Lesquereux & James' Manual of the Mosses of North America and here omitted, are as follows: *Thuidium erectum* is *T. delicatulum*; *T. calyptratum* is a form of *T. microphyllum*; *T. remotifolium* is not a *Thuidium* and *T. tamariscinum* is not known from North America.

branches themselves often give off branchlets as regularly as the pinna of a fern is divided into pinnules.

The stems bear paraphyllia of various sizes and shapes, but all are more or less linear or filamentose, often divided and branched, but not leaf-like. There is often considerable difference between the stem and branch leaves in shape and size. The ovate-triangular stem leaves are usually papillose on both surfaces, unicostate, the costa passing the middle. The median leaf cells vary from roundish quadrate-hexagonal to rhombic-oblong; in two species linear-rhomboidal. The capsules, on smooth pedicels, are annulate, more or less curved. The opercula vary from conic to rostrate; the peristomes are well developed; the endostomial band $\frac{1}{3}$ the length of the teeth, with segments and cilia.

KEY (Illustrated)

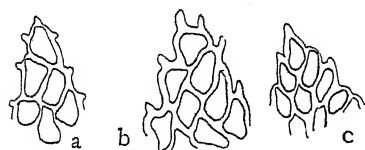


FIGURE 122.

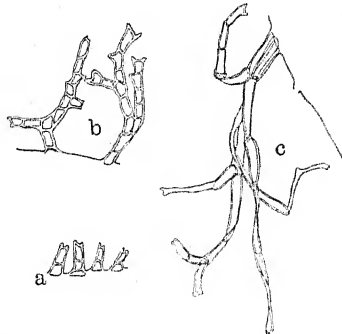


FIGURE 123.

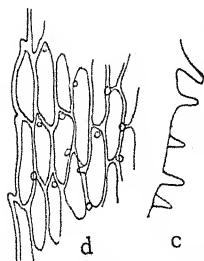


FIGURE 124.

Bipinnate or tripinnate; stem leaves erect spreading when moist (Fig. 128), costate to $4/5$; perichaetial leaves ciliate *delicatulum*.

1. Apical cells of branch leaves crowned with 2-4 papillae (Fig. 122, *a* and *b*); median cells quadrate-hexagonal to oblong-rhomboidal (Fig. 126) 2.
- Apical cells of branch leaves with a single terminal papilla (Fig. 122, *c*); median cells as in 2. Paraphyllia numerous, branched 7.
- Apical cells of branch leaves not papillose; median leaf cells linear-rhomboidal (Fig. 124). Paraphyllia long-linear or filamentose (Fig. 123, *c*) 8.
2. Paraphyllia few, small, linear-oblong, 2-6 cells long (Fig. 123, *a*); branch leaves subcrispate-incurved when dry 3.
- Paraphyllia numerous, more or less branched (Fig. 123, *b*) 4.
3. Plants very small, 1-2 cm.; stem and branches filiform, branches papillose (Fig. 125); growing in thin mats on limestone rocks *pygmæum*.
- Plants small, 2-4 cm.; loosely cespitose; branches smooth; growing on the ground and rotten wood *minutulum*.



FIG. 125.

4. Stems closely pinnately branched, branches teretefoliate when dry 5.
- Stems loosely pinnately or bipinnately branched 6.
5. Plants soft; leaf cells with 2-5 small papillae on each surface (Fig. 126, *a*) *scitum*.
- Plants rigid; leaf cells with a single papilla on each surface (Fig. 126, *b*) *abietinum*.
6. Pinnate or bipinnate; stem leaves spreading-recurved when moist (Fig. 127), costa subpercurrent; perichaetial leaves not ciliate *recognitum*.

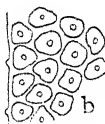
*a**b*

FIG. 126.

Bipinnate; stem leaves with a hyaline filiform acumination; perichætical leaves scarcely ciliate *Philiberti*.

7. Stem leaves (Fig. 129) roundish ovate, abruptly linear-oblong-acuminate, margins erose-serrate *Virginianum*.



FIGURE 127.



FIGURE 128.



FIG. 129.

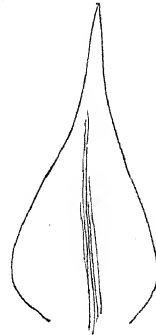


FIGURE 130.

Stem leaves broadly ovate, long and narrowly acuminate, margins crenulate-serrulate or entire (Fig. 130) *microphyllum*.

8. Stem leaves plicate striate, the decurrent base with one to three cilia (Fig. 131); branch leaves loosely appressed when dry *paludosum*.

Stem leaves sulcate, contracted to a decurrent subclasping paraphyllose base (Fig. 132); branch leaves subcrispate when dry . . . *Blandowii*.



FIG. 131.



FIGURE 132.

DESCRIPTION OF FIGURES IN THE KEY

FIGURE 122. Apical cells $\times 430$: a, of *T. minutulum*; b, of *T. delicatulum*; c, of *T. Virginianum*. (Papillæ on surface of cells not shown.)

FIGURE 123. Paraphyllia $\times 215$: a, of *T. minutulum*; b, of *T. delicatulum*; c, of *T. Blandowii*

FIGURE 124. Leaf cells of *T. Blandowii* $\times 430$; c, papillæ of back of leaf seen in profile.

FIGURE 125. Portion of branch of *T. pygmaeum* $\times 110$.

FIGURE 126. Leaf cells $\times 430$: a, of *T. scitum*; b, of *T. abietinum*.

FIGURE 127. Stem $\times 15$ and leaf $\times 20$ of *T. recognitum*.

FIGURE 128. Stem $\times 10$ and leaf $\times 20$ of *T. delicatulum*.

FIGURE 129. Leaf of *T. Virginianum* $\times 60$.

FIGURE 130. Leaf of *T. microphyllum* $\times 60$.

FIGURE 131. Leaf of *T. paludosum* $\times 12$.

FIGURE 132. Leaves of *T. Blandowii* $\times 12$.

**Large species*, see Plate LII.

T. delicatulum (L.) Mitt., the Common Fern Moss, grows in damp shady places over stones and earth, rotten logs and the like. It is bright green at the ends, darker below and very regularly twice or even three times pinnate. It is abundant throughout our range, but does not always fruit freely.

The stem leaves are triangular-ovate, rather gradually acuminate, appressed when dry, *erect-spreading when moist*, margins serrate, more or less recurved;

costa vanishing in the acumen; medium leaf cells quadrate-oblong to oval rhombic; *perichætal leaves ciliate on the margins*; dioicous; capsule cylindrical, curved; operculum conic-rostrate; *spores maturing in winter*. (See Figs. 122, 123, 128, 133 and Plate LII.)

T. recognitum (Hedw.) Lindb. is somewhat less common than the preceding and often grows intertangled with it. The two species are very generally confused and are not always easy to distinguish when sterile. This species is mostly bipinnate and bright yellowish green at the ends of the stems and branches. The broadly triangular, auriculo-cordate, abruptly acuminate stem leaves are sulcate when dry, spreading recurved when moist, usually plane on the serrulate margins; costa subpercurrent, somewhat spreading at apex; median leaf cells oblong-rhombic, passing to oblong-linear at the apex; perichætal leaves not ciliate; dioicous; capsule cylindrical, curved; operculum rostellate; spores in July. (See Figs. 127 and Plate LII.)

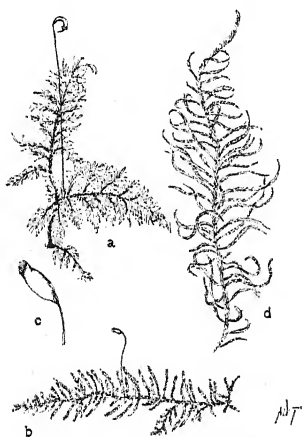


FIGURE 133. a. *Thuidium delicatulum* $\times \frac{2}{3}$. b. *T. scitum* $\times 1$. c. Capsule of the same $\times 5$. d. *T. abietinum* $\times 1$.

The difference in appearance of the stem leaves, particularly when moist, is the most convenient character for distinguishing these two species. Young perichætal leaves of *T. delicatulum* are sometimes destitute of cilia.

T. Philiberti Limpr. is a rare species much like a degenerate form of *delicatulum*. The distinguishing character of this rare species is the hyaline, filiform acumination of the stem leaves which are somewhat intermediate between those of *T. recognitum* and *T. delicatulum*; the median leaf cells are quadrate-oblong rather than oblong-rhombic; costa thin, disappearing above the middle; dioicous; capsule cylindrical, curved; annulus not clearly differentiated; operculum conic-rostrate; spores maturing in October. On swampy grounds and about the base of small trees in wet places. New Jersey, Pennsylvania, Ontario and New Brunswick.

T. Alleni Aust. According to Dr. Best this is synonymous with *T. glaucinum* var. *ludovicianum* Card. This differs from *T. glaucinum* in the lower papillæ, stronger costa and less denticulate branch leaves. From *T. delicatulum* in the non-ciliate perichætal leaves. It is bipinnate; "stem leaves ovate-lanceolate, broadly, shortly and obtusely acuminate." Rare. Connecticut to Louisiana.

T. abietinum (L.) B. & S., the Wiry Fern Moss, is a rather less common moss about the size of *delicatulum*, but simply pinnate and stiff, growing in dense tufts on stones and ledges in drier situations and on dry sterile soil; stem leaves broadly ovate, acuminate, deeply biplicate, margins serrulate;

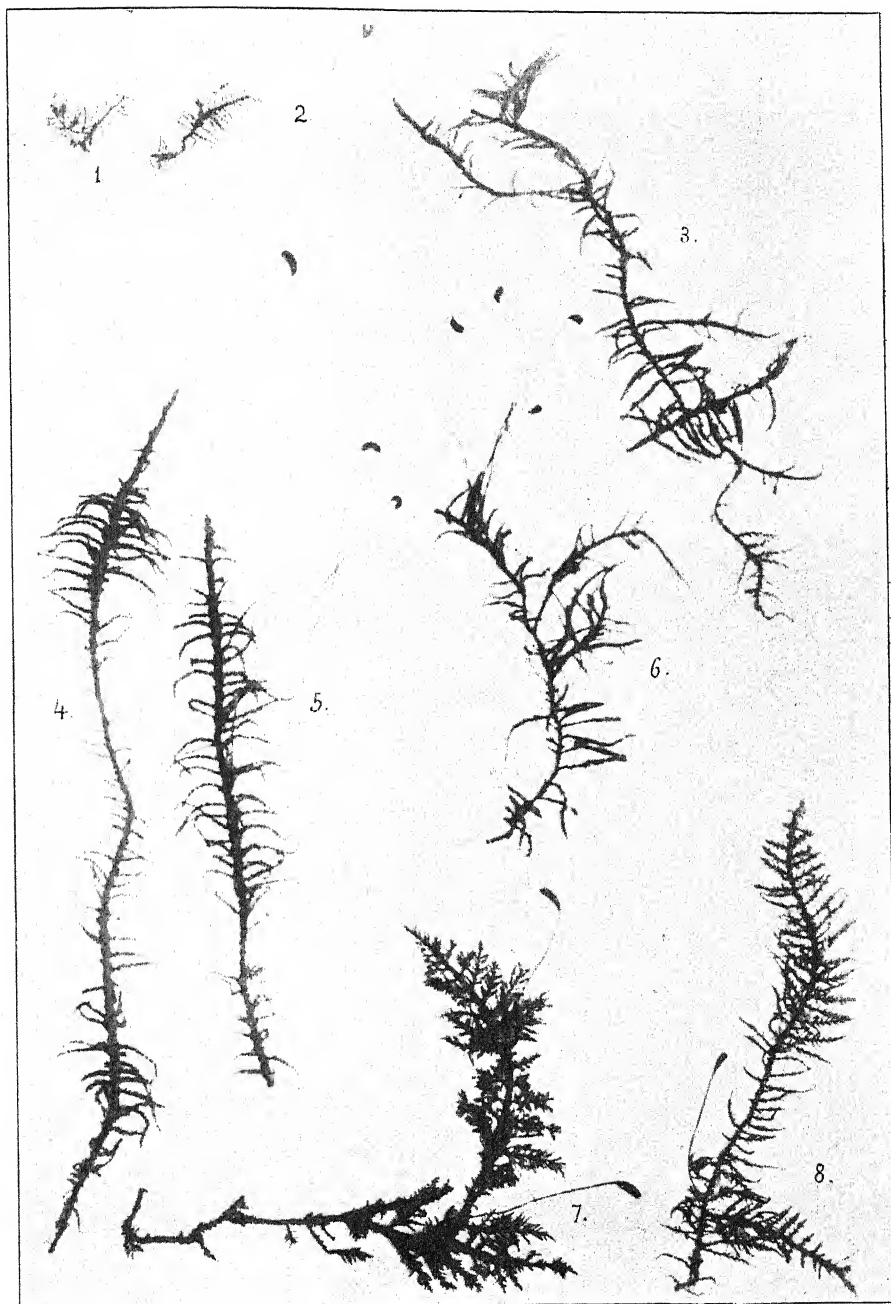


PLATE LII. 1. *Thuidium pygmæum*. 2. *T. minutulum*. 3 and 6. *T. paludosum*.
4 and 5. *T. Blandowii*. 7. *T. delicatulum*. 8. *T. recognitum*.

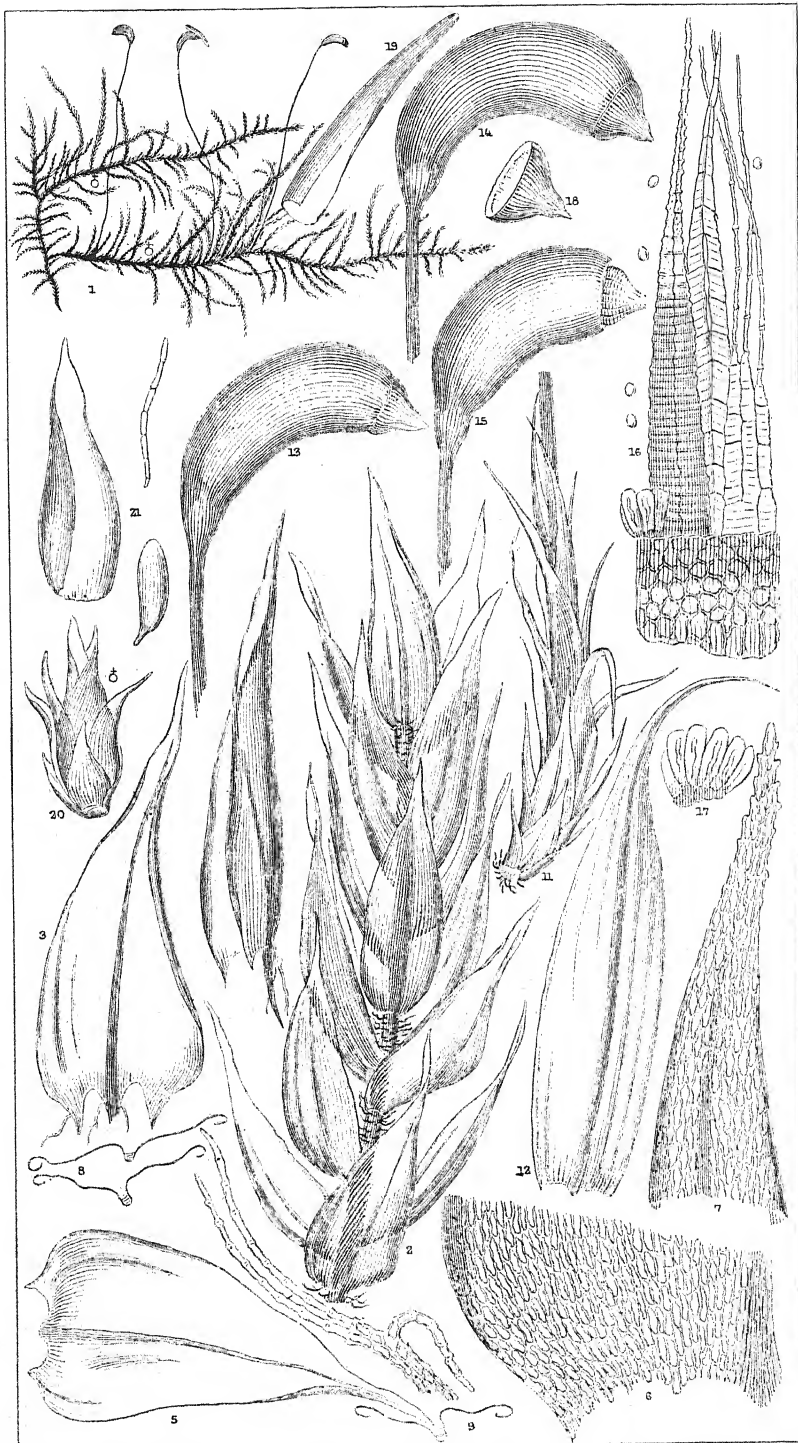


PLATE LIII. *Thuidium paludosum* (From Sulliv. "Icones.")

median leaf cells oval-rhombic; dioicous; capsule narrowly cylindrical, curved; operculum long conic. From Greenland to Virginia and from New Foundland to British Columbia. Sterile here but fruiting in Colorado and Montana and fruiting freely in Alaska. (Fig. 133.)

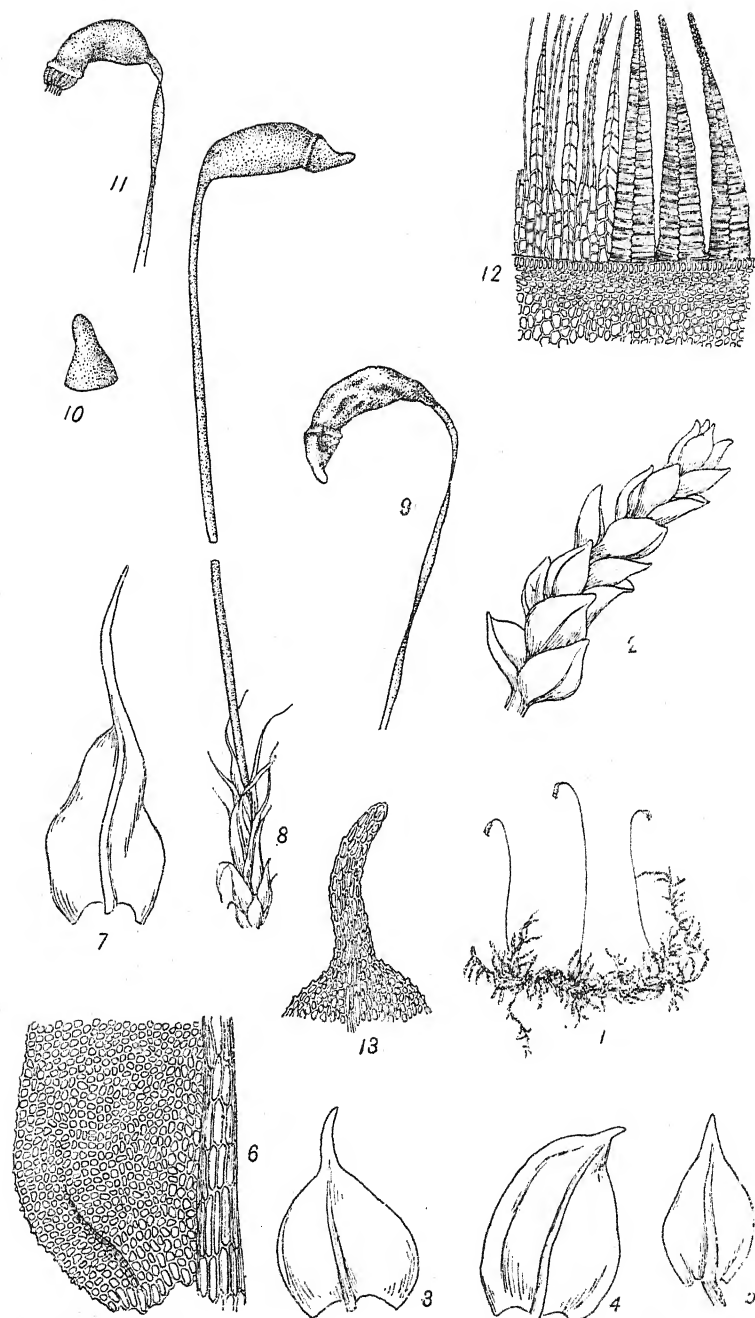
T. Blandóvii (W. & M.) B. & S. is another large species regularly and simply pinnate, erect, and softer than most species. The stems and branches are covered with a paraphyllose tomentum; the stem leaves have long paraphyllia-like appendages at base, as shown in Fig. 132; the stem leaves are ovate-triangular, narrowly acuminate, margins sinuate-serrulate, costa disappearing above the middle; median leaf cells oblong-fusiform to linear-rhomboidal, with a large papilla on the distal end of each on the lower surface, smooth or nearly so on the upper; monoicous; capsule oblong cylindrical, curved; operculum conic; spores maturing in July. On marshy ground, with a northern range. From Greenland to Vermont, southward to New Jersey, westward to Idaho and British Columbia. (Figs. 123, 124, 132 and Plate LII.)

T. paludosum (Sulliv.) Rau and Hervey (*Hypnum paludosum* Sulliv.) is a common species in swamps and wet grassy fields in the Eastern and Middle States. At first sight the student will hardly place it among the Fern Mosses, as it is irregularly pinnate with leaves often scarcely papillose. It will perhaps be most easily recognized by the paraphyllia, somewhat similar to those on the preceding species, and the somewhat similar paraphyllose filaments at the base of the stem leaves, which are somewhat rigid, oblong-lanceolate, acuminate, plicate-striate; costa subpercurrent; median leaf cells oblong to linear-rhomboidal, smooth or with a small papilla at the distal end of each on the lower surface, rarely on both; monoicous; capsule oblong-cylindrical, curved; operculum conic, apiculate; spores maturing in winter—var. *elodioides* (R. & C.) Best; often dark green, leaves smaller, more strongly papillose, papillæ sometimes subcentral, margins dentate-serrate. New York and westward. (Fig. 131, and Plates LII and LIII.)

* * *Medium-sized species simply and regularly pinnate.*

T. scitum (Beauv.) Aust. This neat trim moss grows in mats on the roots and bases of trees. Stem leaves broadly triangular, auriculo-cordate, narrowly acuminate; branch leaves broadly ovate-acuminate; median leaf cells roundish-hexagonal with 2 to 5 small bead-like papillæ on each surface; monoicous; capsule cylindrical, straight, or but slightly curved; operculum conic-rostrate; spores maturing in autumn and winter. Var. *æstivale* (Aust.) Best; stems not so closely pinnate; capsule oblong-cylindrical, inclined to horizontal; operculum shorter beaked. From Canada to North Carolina and from Vermont to Wisconsin. (Fig. 133.)

T. Virginianum (Brid.) Lindb. (*T. gracile* var. *Lancastriense* S. & L.). Plants small, dark or dirty green, in open woods on the ground or about stumps and



E.L. HYATT Del.

PLATE LIV. *Thuidium Virginianum*. (From the Bulletin of the Torrey Botanical Club, by permission.)

roots of trees; *stem leaves roundish ovate, abruptly acuminate* (Fig. 129); costa vanishing in the acumen; erose-dentate below, serrate above; leaf cells oblong-quadrate to hexagonal *with a single papilla*; acumen of the branch leaves short, broad, sharply serrate; median leaf cells quadrate-hexagonal; monoicous; capsule cylindrical, curved; operculum short beaked, obtuse; spores maturing in spring. From Massachusetts to Minnesota, south to Mexico. This is readily distinguished from the preceding by the unipapillate leaf cells and curved capsules, and from the next by the shape of the stem leaves (Figs. 122, 129, and Plate LIV).

T. microphyllum (Sw.) Best. (*T. gracile* Br. & Sch.). Plants of medium size, pale green, becoming yellowish. Stem leaves broadly ovate to ovate-lanceolate, *long and narrowly acuminate*; margins sinuate-serrulate or entire; costa subpercurrent; median leaf cells quadrate-oblong to oval-rhombic, *unipapillate*, monoicous; capsule oblong, curved; operculum short-conic, acute or obtuse; spores maturing in summer. Var. *Ravenellii* S. & L.: a stunted form growing in sand or on stones in the Southern States. Var. *lignicola* (Kindb.) Best: somewhat larger than the type, yellowish or rufescent, margins of stem leaves more or less recurved, median leaf cells rhombic to short rhomboidal; capsule more turgid. Northward and westward—on rotten wood, bark of decaying trees, rarely on stones or the ground. From New Mexico to Florida, northward to Canada, westward to British Columbia. (Fig. 130 and Plate LV.)

* * * *Species small, simply pinnate (see Plate LII); papillæ several on each cell.*

T. pygmæum Br. & Sch. For fineness and for beauty this little moss, appearing when dry like miniature embroidery, leads the Thuidiums. The paraphyllia, found only on the papillose branches, are so small as easily to be overlooked. The median leaf cells of the triangular-ovate stem leaves are quadrate-hexagonal and the operculum of the asymmetric oblong-ovate capsule obliquely rostrate; monoicous; spores maturing in autumn. Canada, Ohio, New Jersey and Pennsylvania.

T. minutulum (Hedw.) Br. & Sch. Although quite small, this species differs from the preceding chiefly in being larger. Paraphyllia on both stems and smooth branches; median leaf cells quadrate-hexagonal, the marginal somewhat larger; monoicous; capsule oblong-oval, rough, slenderly rostrate.

Its usual habitat, in the northern part of its range, is rotten wood; in its southern, the ground. The spores mature in autumn. From New Brunswick to Minnesota and from Canada to Florida.

Heterocladium squarrosulum (Voit.) Lindb. is a rare subalpine species strongly resembling the smaller species of *Thuidium*, but the plants are less regularly pinnate and the costa is *short, thin, divided or bicostate*. It has been found in southern Vermont and northwards. It should be looked for in the northern Berkskires and in the Adirondacks.

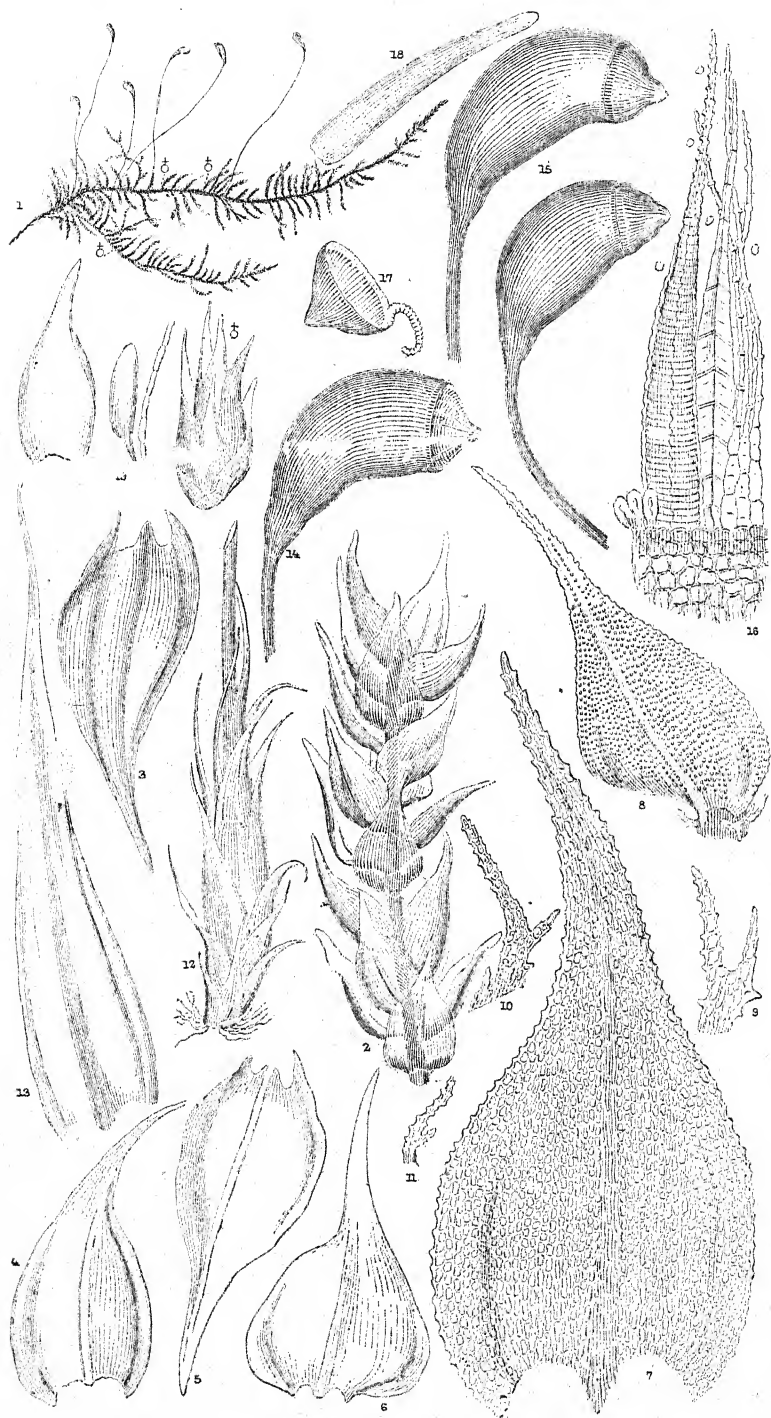
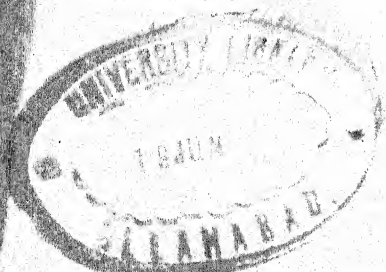


PLATE LV. *Thuidium microphyllum*. (From Sulliv. "Icones.")





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